RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

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Meningiomas of the Posterior Cranial Fossa[1]

THEODORE A. TRISTAN, M.D.,[2] and PHILIP J. HODES, M.D.

MENINGIOMAS of the posterior cranial fossa are difficult to diagnose but, when detected, are often amenable to surgical removal. The clinical, roentgen, and surgical features of these lesions have been ably described in the comprehensive treatise by Castellano and Ruggiero in 1953 (5) and in other reports (4, 6-8, 15-18, 21, 26, 34, 39-42). It is the purpose of this article to present the findings observed in patients at the Graduate Hospital and the Hospital of the University of Pennsylvania from the year 1918 through 1955. The study is based on the records of 59 of 64 patients, most of whom were operated upon by Dr. Francis Grant[3] and Dr. Robert Groff.[4] Radiographs were available for review in only 26 cases; in the others the radiologic interpretations were consulted.

INCIDENCE

This series represents approximately 1 in 12 of all patients with verified intracranial meningiomas operated upon by Grant and Groff, a proportion similar to that reported by Cushing and Eisenhardt (7), Dandy (see Gonzalez Revilla, 14a) Horrax (21), and Campbell and Whitfield (4). The ages of the patients at the time of the diagnosis of posterior fossa meningioma were as follows:

	Males	Females	Total
Less than 10 years	1	0	1
11-20 years	0	2	2
21-30 years	5	4	9
31-40 years	3	7	10
41-50 years	5	15	20
51-60 years	8	8	16
61-70 years	0	1	1
over 70 years	0	0	0
TOTALS	22	37	59

The 71 cases reported by Castellano and Ruggiero constituted 8.45 per cent of proved meningiomas from the Serafimer Hospital, Stockholm (803 cases or 19.2 per cent of a total of 4,185 verified intracranial brain tumors).

Gliomas are the commonest neoplasm occurring in the posterior fossa. The acoustic neurinoma is the second in frequency, and meningiomas the third. The ratio of neurinoma to meningioma has been variously given as 6 to 1 (5), 9 to 1 (4), 10 to 1 (18), and 15 to 1 (39).

CLASSIFICATION AND DISTRIBUTION

While posterior fossa meningiomas have been classified by different authorities in

[1] From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna., and Penn Mutual Life Insurance Company Foundation for the Study of Neoplastic Disease. Presented as part of a Symposium on Neuroradiography at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956.

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TABLE I: DISTRIBUTION OF CASES ACCORDING TO THE CLASSIFICATION OF CASTELLANO AND RUGGIERO (5)

Class	Males	Females	Total
I	5	9	14
II A	4	1	5)
B	1	2	3) 8
III	9	19	28
Left	3	11	14
Right	6	8	14
IV	2	0	2
V	0	3	3
Miscellaneous			
Multiple	0	3	3
Sarcoma	1	0	1
TOTAL	22	37	59

from two to five major groups, we have adopted the classification offered by Castellano and Ruggiero, based on the method for classifying supratentorial meningiomas, by the site of dural origin or attachment. The posterior fossa meningiomas arise in the following sites: Class I, cerebellar convexity; Class II, tentorium cerebelli; Class III, posterior surface of the petrous portion of the temporal bone (meningiomas of the cerebellopontine angle); Class IV, clivus; Class V, foramen magnum.

Among our patients were some in whom it was extremely difficult or even impossible to tell from which portion of the dura in the posterior fossa the meningioma arose. Occasionally, the operative report failed to mention specifically the site of attachment.

The number of cases in each of the categories outlined above, and described in greater detail below, is shown in Table I. The illustrative material presented was selected primarily to demonstrate those diagnostic points that proved significant in the early recognition of the tumor. Other information about the survival and operative mortality in this group of patients is presented in Table II. The longest survival is that of a man with a cerebellopontine angle meningioma who lived thirty-two years after operation and died of heart disease.

SYMPTOMATOLOGY

Few intracranial tumors offer as much difficulty in diagnosis as posterior fossa meningiomas. The clinical picture varies remarkably, depending upon the location and size of the tumor. The problem often is not solely one of localization, but even of recognition that an intracranial tumor is present (39). The study of our material and a review of the literature emphasize

TABLE II: FOLLOW-UP DATA
(Total cases, 64. Records available, 59. Followed, 53)

Dead		Alive	
Postoperative (30 days)	17	Alive up to one year	5
Died within one year	5	Alive up to two years	1
Died between one and two years	3	Alive up to three years	3
Died between two and three years	3	Alive up to four years	2
Died between three and five years	0	Alive up to five years	7
Died between five and ten years	2	Alive up to ten years	1
Died after 32 years	1	Alive up to fifteen years	2
		Alive up to sixteen years	1
TOTAL	31	TOTAL	22

Cases surviving five years, 14
All cases: postoperative deaths 33 per cent
Five year survivals: 42 cases operated before 1955, 35 per cent

the need for a high index of suspicion for posterior fossa meningiomas, since the symptoms are easily confused with those of such permanently disabling diseases as syringomyelia, amyotrophic lateral sclerosis, multiple sclerosis, and myelodysplasia.

Headache, in particular suboccipital headache, is an early and common complaint. Sometimes the pain radiates throughout the entire neck, and the shoulder girdle and upper limbs may be affected. Hemiplegia, triplegia, and even tetraplegia may ensue as a late complication. At times, a posterior fossa meningioma may be recognized by the posture of the head, which is held forward and slightly flexed in an attitude described as "ceremonial" (37). In other instances the head and neck may be tilted to one side, due to intracranial pressure exerted through the foramen magnum upon nerves in the neck.

Involvement of cranial nerves simplifies localization of the tumor. Posteriorly placed tumors may cause difficulty in

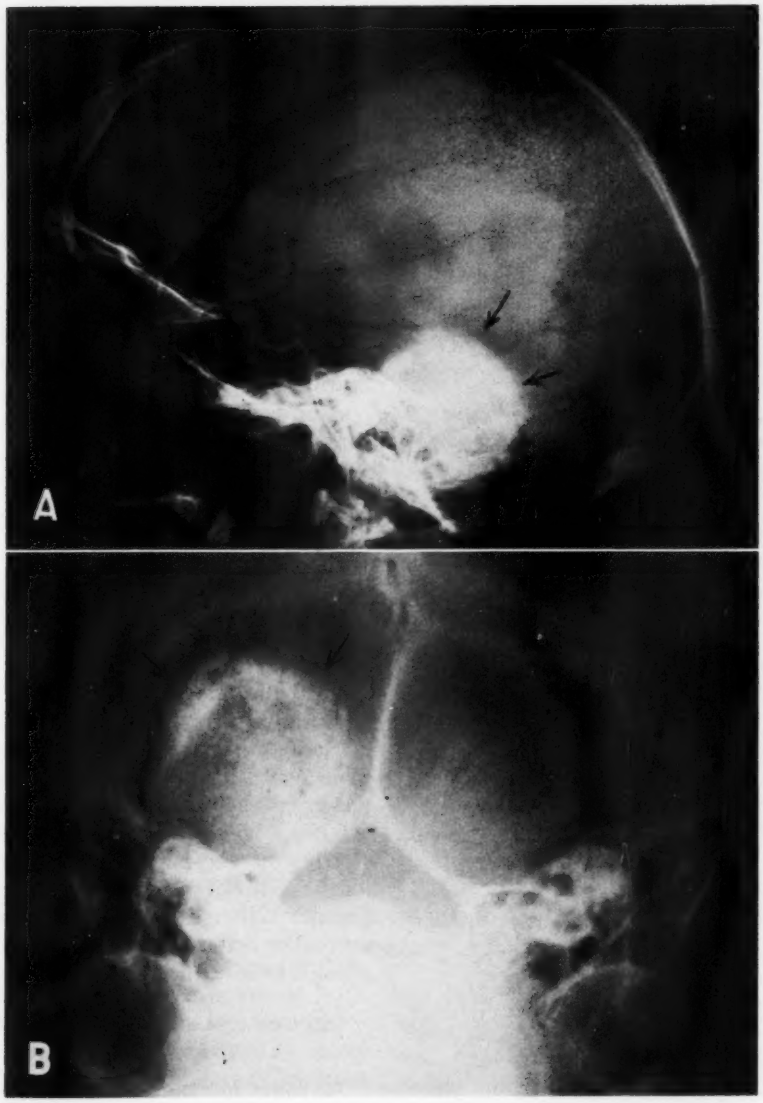


Fig. 1. Class I meningioma of the cerebellar convexity.

Clinical History: E. C., a 44-year-old white woman, entered the hospital with a history of headache for seven years, deafness in the right ear for two years, dizziness and wobbling gait for two months, and sudden onset of "tunnel vision" just prior to admission. The corneal reflex was absent on the right; a slight right facial weakness was observed. The patient had involvement of the eighth nerve on the right with nystagmus and loss of hearing. In addition, she was unable to perform successive movements of the extremities. Suboccipital craniectomy was performed, with removal of a 75-gm. tumor which presented just above the jugular bulb behind the mastoid and had its dural attachment in that region. The patient made an uneventful recovery and survived for eight years asymptomatically. She died in a disaster fire.

A. *Lateral Projection:* A large calcified mass is seen in the posterior cranial fossa.

B. *Anteroposterior Projection:* The tumor appears to lie deep in the cerebellar lobe. No destructive or reactive bone changes are visualized.

speaking, swallowing, and even breathing. Tumors arising from the cerebellopontine angle cause tinnitus, deafness, facial weakness, and corneal hypesthesias. Classical tic douloureux may be mimicked in those cases in which the trigeminal nerve is involved.

These meningiomas usually grow slowly and allow ample opportunity for vital structures to accommodate themselves to local conditions. In certain areas, particularly in the region of the cisterna magna, large spaces exist which can harbor sizable tumors without significant effect on perifocal nerve structures (3, 16, 35). Increased intracranial pressure, with papilledema and blindness, and the roentgen manifestations of internal hydrocephalus may not appear until late.

MENINGIOMAS OF THE CEREBELLAR CONVEXITY (CLASS I)

Included in Class I are those tumors having an origin in the "dura beneath the anterior margin of the transverse sinuses and behind that of the sigmoid sinuses, *i.e.*, the dura covering the inferior, convex surface of the cerebellum" (5).

Our series included 14 tumors of this class, as compared with 7 found by Castellano and Ruggiero. While we recognize that this number may be an overestimate on our part, it represents the best classification possible on the basis of the information available as to symptoms, radiological and surgical findings, and pathologic evaluation.

Symptoms of increased intracranial pressure are outstanding as a general rule; cranial nerve changes appear late and include affections of the fifth, sixth, seventh, and eighth cranial nerves. More than half of the patients reveal cerebellar dysfunction and nystagmus (5).

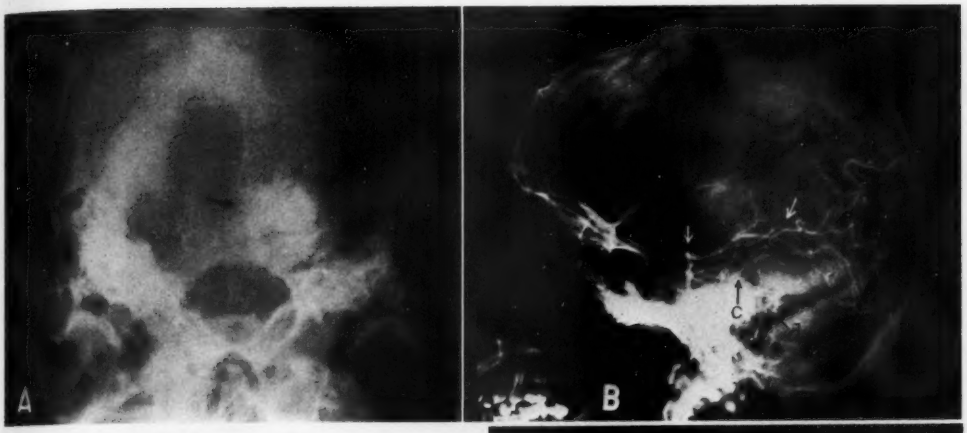
The effects of increased intracranial pressure, such as abnormal prominence of digital markings on the calvaria, and the presence of bone absorption in the region of the sella turcica, may be demonstrated on routine radiographs. The tumor may cause focal absorption or destruction of bone, with or without secondary new bone proliferation. Psammomatous calcification can frequently be demonstrated (Figs. 1 and 2).

Internal hydrocephalus, caused by pressure upon the fourth ventricle and the aqueduct of Sylvius, often can be shown pneumoencephalographically in meningiomas of the cerebellar convexity. When large enough, such a lesion may encroach upon the ipsilateral temporal horn and displace it upward, so that the floor may appear concave. When located laterally, the lesions may shift the midline structures to one side. A more significant sign is upward displacement of the posterior portion of the third ventricle by the tumor. This change in the third ventricle, together with anterior displacement of the aqueduct of Sylvius and the fourth ventricle, suggest a convexity lesion. Body-section roentgenography should be used to demonstrate these midline structures clearly (14, 29). Often they are not well visualized on routine pneumoencephalograms.

Vertebral angiography is receiving wider acceptance as an aid in the earlier diagnosis of lesions in the posterior fossa. Displacement upward of the homolateral posterior cerebral and superior cerebellar arteries, with either lateral or medial shifting of these structures, may permit localization of a posterior fossa meningioma. Changes in the basilar and inferior cerebellar arteries may occasionally outline a lesion (Fig. 2).

MENINGIOMAS OF THE TENTORIUM CEREBELLI (CLASS II)

In some instances, meningiomas of the tentorium arise from its inferior surface and lie in a totally infratentorial position (Class II-A); such lesions are true posterior fossa meningiomas. A second group of meningiomas must be considered as posterior fossa lesions, at least in part. While they arise supratentorially, they "perforate" or grow through the tentorium and invade the posterior fossa secondarily (Class II-B).



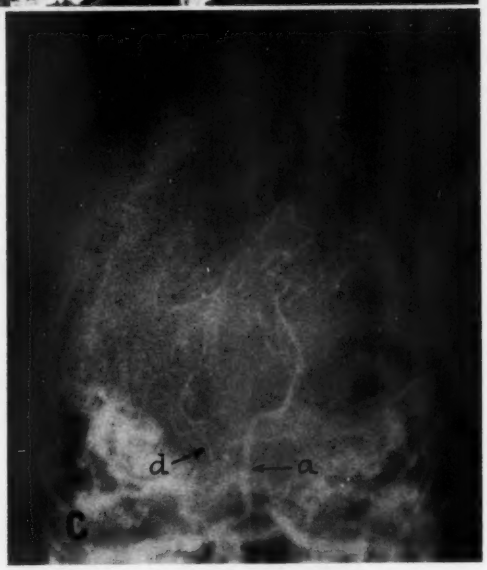


Fig. 2. Class I meningioma of the cerebellar convexity.

Clinical History: J. M., a 27-year-old white priest, entered the hospital complaining of left suboccipital headaches of short duration, but of increasing severity and frequency, noted for a period of two months. For the two weeks preceding admission he had become increasingly ataxic, falling to the left, and had experienced subjective vertigo and tinnitus in the left ear. Bilateral papilledema and a horizontal nystagmus, more marked on looking to the left, were observed. The Romberg test was positive, with falling to the left, and dyssynergia was manifest on the left finger-to-toe and heel-to-knee tests. Suboccipital craniectomy was performed and a tumor weighing 32 gm. was removed. The patient recovered uneventfully and was living and well two years later.

A. *Anteroposterior Projection:* Calcified mass deep in the cerebellum on the left, without evidence of erosion or reactive sclerosis of bone.

B. *Left Vertebral Arteriogram, Lateral Projection:* The inferior cerebellar artery, *d*, is displaced upward over the mass. The basilar artery is seen at *a*, the posterior cerebral artery at *b*, and the superior cerebellar artery at *c*.

C. *Left Vertebral Arteriogram, Anteroposterior Projection:* Slight medial displacement of the basilar artery, *a*, and more definite medial displacement of the inferior cerebellar artery, *d*.

A selective site of attachment for this class of posterior fossa meningiomas is in the posterior half of the tentorium cerebelli; here arachnoid cells cluster in abundance (5). Other meningiomas, arising primarily from the upper surface of the tentorium, nevertheless exert pressure on infratentorial structures. The symptoms caused by such tumors may be indistinguishable from those observed in patients with true posterior fossa meningiomas.

Only 8 meningiomas of the tentorium cerebelli could be identified with certainty in our material. Castellano and Ruggiero noted 21 cases. For the reasons mentioned in the discussion of Class I tumors, there is a possibility that some of these may have had dural attachment to the tentorium cerebelli which was not recognized at operation.

Diffuse headache is almost always the predominant symptom in this group. Vomiting and vertigo are seen in over half the patients. Objectively, papilledema is the most common sign; ataxia, nystagmus, and ultimately cranial nerve disturbances complete the clinical picture.

In routine radiographs of the skull, calcification may be seen in the extensive lesions, much as in cerebellar convexity

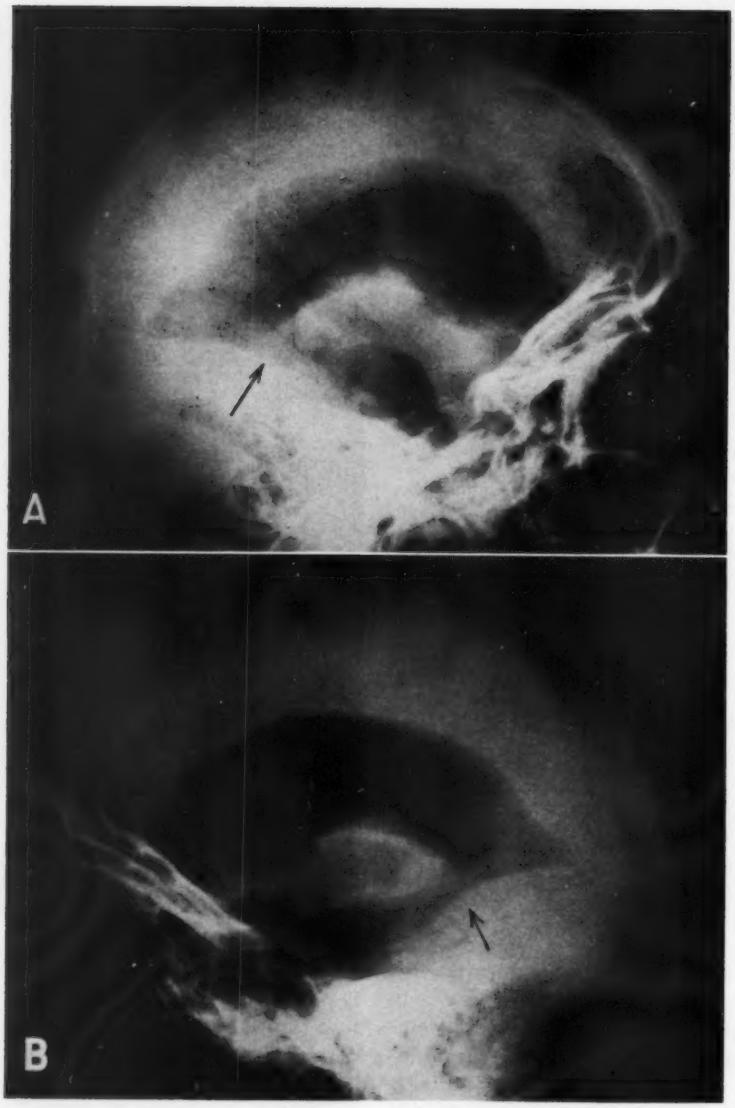


Fig. 3. Class II-A meningioma of the tentorium cerebelli.

Clinical History: M. C., a 54-year-old white housewife, entered with symptoms of vomiting, headache, intermittent double vision, and dizziness, all present for eight months and progressing in severity. Bilateral intention tremor, generalized hypertonia with stiffness of the left leg, bilateral dysdiadochokinesia, bilateral papilledema, and a staggering, broad-based gait were the major objective findings. A 53-gm. tumor was removed from the right cerebellar hemisphere at suboccipital craniectomy, and the patient was living and well six years after operation.

A. *Left Lateral Ventriculogram:* The posterior and temporal horns on the left are well filled and, while enlarged, do not appear displaced.

B. *Right Lateral Ventriculogram:* While the ventricular system appears well filled, there are elevation of the posterior horn (at the arrow) and thinning of the temporal horn, which is slightly elevated, as if pushed up by the subtentorial tumor.

meningiomas. Roentgen manifestations of increased intracranial pressure may also be observed. The findings in air studies may parallel those observed in Class I tumors. Forward displacement of the aqueduct of Sylvius, however, may result in a kinked appearance when the tumor is attached to the tentorium posteriorly. In such instances, the cerebellar vermis is displaced anteriorly and the distal segment of the aqueduct is stenosed. If the tumor is attached to the anterior edge of the tentorium, the brain stem is displaced forward and the cerebellar vermis downward, thereby straightening the sylvian aqueduct and encroaching upon it at a point closer to the fourth ventricle. In either instance, the basal cisterns are flattened, particularly the cisternae pontis and interpeduncularis.

Visualization of air-filled structures in the posterior fossa is more difficult when tentorial meningiomas are present; it is relatively unimpaired in the case of convexity meningiomas.

Perforating meningiomas not only show roentgen evidence of a space-occupying lesion in the posterior fossa, as described above, but also may distort the occipital pole of the ipsilateral ventricle (Fig. 3).

The findings on vertebral angiograms are similar in Class I and Class II.

In meningiomas of Class II-B which perforate the tentorium, a significant change in the anatomy of the internal carotid artery and its branches may be revealed by internal carotid cerebral arteriography (19, 20); the anterior cerebral artery may show uncoiling indicative of ventricular dilatation. The posterior cerebral artery may be displaced upward. A combination of these findings suggests the presence of a tumor of the tentorium cerebelli which interferes with drainage from the aqueduct of Sylvius or its environs (Fig. 4).

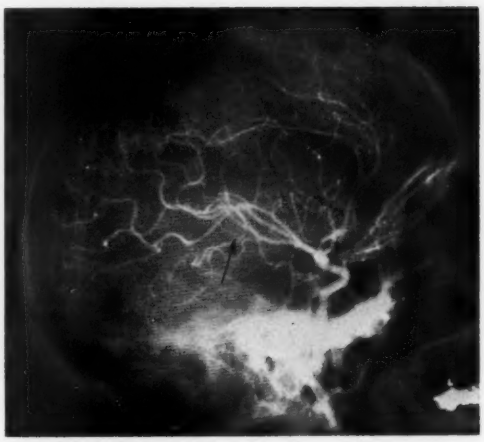


Fig. 4. Class II-B meningioma of the tentorium cerebelli (perforating).

Clinical History: M. M., a 34-year-old housewife, had experienced increasing occipital headache for two years, with impairment of vision and memory. Six months before admission she was no longer able to read. Two months prior to admission she delivered a normal male infant. Shortly before entering the hospital she was seen by her physician because of a severe upper respiratory infection. He discovered bilateral papilledema and a right homonymous hemianopsia.

The patient was somnolent and uncooperative. She had anomia and word blindness but was not ataxic or dyssynergic, had had no nausea or vomiting, and showed no pathologic reflexes or positive cerebellar signs. Carotid arteriography was performed.

Left Percutaneous Carotid Arteriogram: The anterior cerebral artery is uncoiled, indicating ventricular dilatation. There is upward displacement of the posterior cerebral artery (at the arrow). This combination of events could be due only to a tentorial lesion obstructing the aqueduct. The significance of these findings was missed prior to left parieto-occipital craniotomy, at which time a 110-gm. meningioma perforating the tentorium was removed. The patient is living and well at the time of this report, twelve years postoperatively.

MENINGIOMAS OF THE POSTERIOR SURFACE OF THE PETROUS PORTION OF THE TEMPORAL BONE (CLASS III)

Meningiomas arising from the dura mater covering the posterior surface of the petrous portion of the temporal bone are cerebellopontine angle tumors and are the commonest type of posterior fossa meningioma.

Signs of cranial nerve involvement are the most frequent clinical findings, and are often the same as those of acoustic neurinoma. The auditory (eighth) nerve is affected in 80 to 100 per cent of the cases (5, 17, 18); partial or complete unilateral deafness, often of long duration, and tinnitus are the two commonest findings. If the eighth nerve is not involved, the onset of symptoms is almost always associated with other cranial nerve disturb-

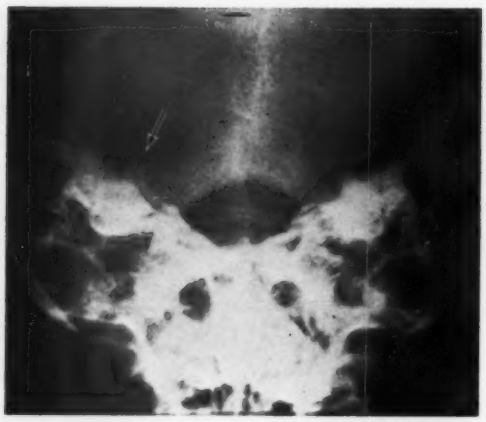


Fig. 5. Class III meningioma arising from the posterior surface of the petrous portion of the temporal bone.

Clinical History: C. S., a 32-year-old colored housewife, gave a history of the onset of diffuse but severe pain behind her right ear ten months prior to surgical exploration. Subsequently deafness and tinnitus appeared on the right side. The patient became quite dizzy and experienced blurring of vision on right lateral gaze. Hoarseness and dysphagia appeared just before admission to the hospital. Total paresis of the right fifth, sixth, and eighth cranial nerves and partial paralysis of the right seventh nerve, as well as an ataxic gait and increased reflexia on the right side, were noted. Suboccipital craniectomy was performed, with removal of a 33-gm. meningioma from the posterior surface of the petrous portion of the right temporal bone. Brain stem damage occurred during removal, and the patient died on the thirteenth postoperative day.

Anteroposterior Projection: Abnormal exostosis arising from the petrous portion of the temporal bone on the right.

ances: trigeminal pain, facial twitching, loss of sensation in the distribution of the fifth nerve (corneal reflex), and difficulty in swallowing.

In 1947 and 1951, Hodes *et al.* (17, 18) reported a series of 183 patients with cerebellopontine angle tumors. Of this group, 19 were meningiomas (10.4 per cent), and of these more than half revealed roentgen evidence of increased intracranial pressure. Abnormalities were noted in the region of the petrous apex in about the same number. Evidence of increased bone density in this area was observed more commonly than was erosion, and the involvement tended to be diffuse.

Increased bone density rarely occurs in the petrous tip in cases of proved acoustic neurinoma or neurofibroma (2, 6, 18, 28, 14a). An exostosis or hyperostosis in this region, therefore, is indicative of a cerebellopontine angle meningioma rather than an eighth nerve tumor (Fig. 5).

Bone destruction caused by meningioma in the petrous apex may be accompanied by calcific débris within the tumor (Fig. 6).

The importance of air studies in patients with cerebellopontine angle tumors has been repeatedly emphasized (5, 10, 12, 13, 22, 23, 25, 25a, 29, 30, 31, 34, 41, 42, 44, 45). There exists an "upward transtentorial herniation" of the brain stem and cerebellum in these posterior fossa meningiomas, a concept clearly described by Ecker (10), accounting for the encephalographic findings. The lateral ventricles, the third ventricle, and the most proximal portion of the sylvian aqueduct are dilated. As a rule, the fourth ventricle is either not demonstrated, or is shifted posteriorly, and the cisterna pontis is seen only with great difficulty. The aqueduct of Sylvius may also be displaced laterally by the cerebellopontine angle mass. The distal portions of the third ventricle may be similarly displaced. More commonly, the third ventricle is shifted upward, its floor becoming bowed, with the concavity directed caudad, as indicated by Epstein *et al.* (12–14). In this situation, the proximal end of the aqueduct of Sylvius is displaced dorsally.

When filled with air, the third and fourth ventricles are easily demonstrated; occasionally, however, an unqualified opinion cannot be given. Often lateral displacement of these structures can be best shown in body-section radiographs (14, 18, 29) (Fig. 7).

With vertebral arteriography, many Class III meningiomas can be demonstrated. One may observe the "tumor stain" in some instances; more significant, however, are distortions of normal vascular relationships (24, 33, 36, 43). The basilar artery lies close to and somewhat parallel to the clivus and therefore forms an extremely important landmark for assessing abnormalities of the posterior fossa. It may be displaced laterally or backward;

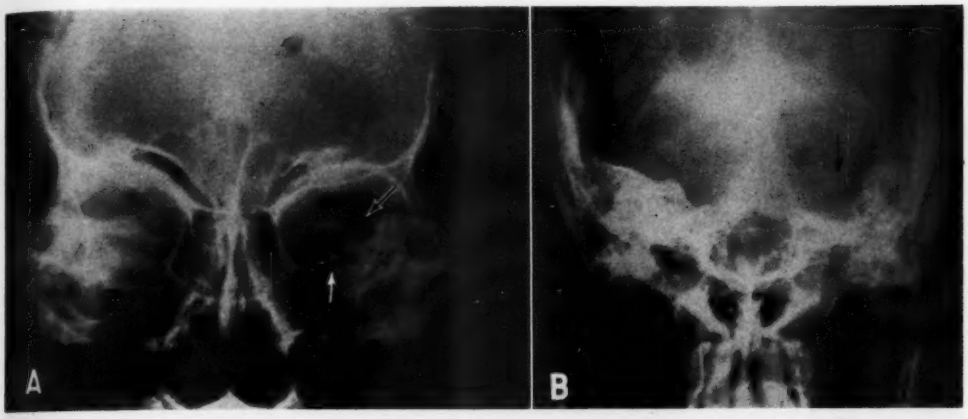


Fig. 6. Class III meningioma arising from the posterior surface of the petrous portion of the temporal bone.
Clinical History: B. G., a 47-year-old housewife, had experienced increasing loss of control of the right leg for three years. She had staggering gait, impaired hearing on the left, and transient dizziness associated with diplopia. Nystagmus was present on right lateral gaze; bilateral papilledema was noted, and the hearing loss on the left was confirmed. In addition, a positive Romberg sign to the right was elicited, and the patient staggered to the same side. Aphonia was noted, and adiadochokinesis, especially marked on the right, with associated poor coordination of the right arm and leg, was present. The left corneal reflex was diminished and there was a positive Bárány test on the left. Biopsy of a cerebellopontine-angle tumor on the left was attempted, but because of increased and uncontrollable ventricular pressure the operation was discontinued. Two months later removal of a 26-gm. left cerebellopontine-angle meningioma was accomplished, but serious hemorrhage under the brain stem at the time of surgery resulted in death on the second postoperative day.
A. *Postero-anterior Projection:* The destruction of the left petrous apex is associated with calcification both in the area of destruction and immediately surrounding it (arrows).
B. *Anteroposterior Projection:* Destruction and calcific débris seen to somewhat better advantage at the arrow.

sometimes it may be crushed against the clivus (33).

MENINGIOMAS OF THE CLIVUS (CLASS IV)

Meningiomas of the clivus are difficult to localize clinically. The patients present with cranial nerve disturbances, a decrease in the corneal reflex being the commonest finding. Atypical facial paresis is the next most frequent symptom, with impaired hearing almost as common. The symptom complex develops slowly; as a group, these patients are not severely affected early in the course of the disease.

Usually, little is seen in the routine radiographs. Occasionally, the dorsum sellae and clivus may reveal hyperostosis (Fig. 8). Air studies and vertebral arteriography are required to make the diagnosis, as noted by Lindgren (24) and Radner (36). The aqueduct and fourth ventricle may be displaced posteriorly either by this lesion or by tumors arising within the pons; these lesions, therefore, may be indistinguishable from each other. In any event, lumbar pneumoencephalography must be the method of choice to demonstrate that the lesion is out of the brain stem or "extracerebral" (5). The dangers of such a procedure in the face of intracranial hypertension are all too well documented (34). Vertebral arteriography thus becomes the method of choice, since clivus meningiomas may displace the entire basilar artery posteriorly (36). The absence of posterior displacement of the vessel, or segmental displacement only, must be viewed with caution, however, since the basilar artery may run over the ventral surface of the tumor immediately adjacent to the clivus. Dorsal displacement of the superior part of the artery and lateral displacements are found in nontumor cases (24, 36) and have been demonstrated as anatomic variants (20).

Clivus meningiomas, unfortunately, are inoperable; there has been no reported case of successful removal of a true clivus meningioma. Suboccipital decompression is the treatment of choice (5).

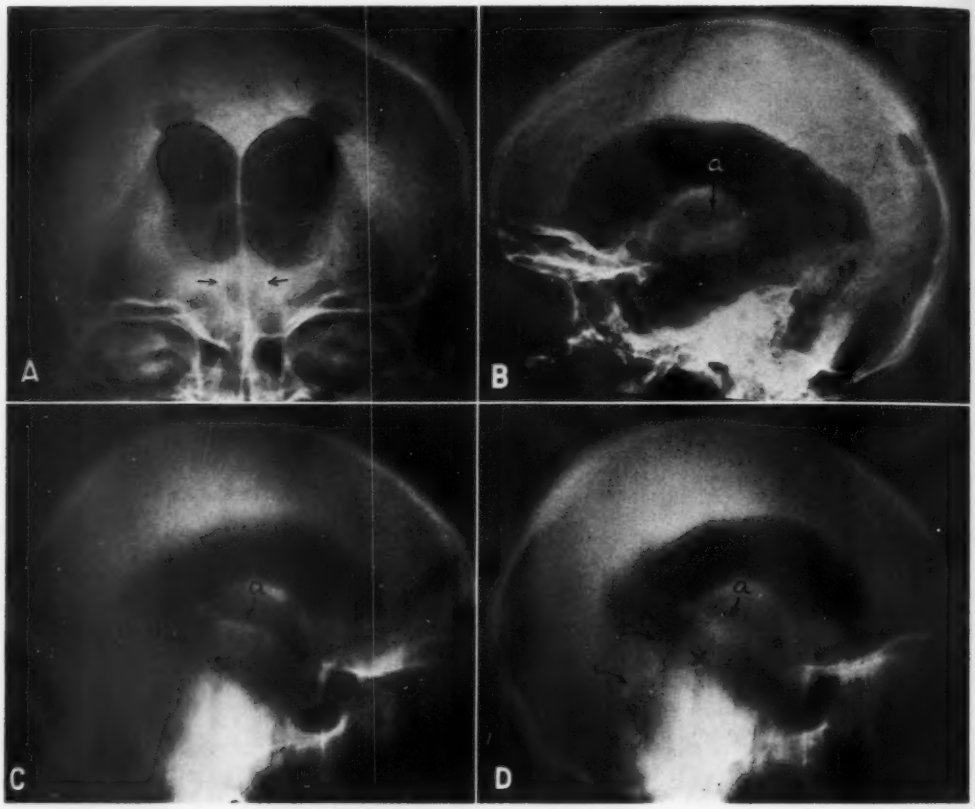


Fig. 7. Class III meningioma arising from the posterior surface of the petrous portion of the temporal bone.
Clinical History: M. L., a 56-year-old white housewife, was admitted because of deafness in the left ear for ten years, frontal headache present for one year, and difficulty in walking, with diplopia and dizziness, for several weeks. The objective findings included: hypesthesia of the first and second divisions of the left trigeminal (V) nerve; absence of left knee and ankle jerks; right lower facial (VII) nerve paralysis; left upper facial (VII) nerve weakness; diminution of corneal reflex bilaterally; inconstant nystagmus on left lateral gaze; stiffness of the neck; bilateral papilledema. The Bárány test was positive on the left side. A medium-sized tumor was removed from the left cerebellopontine angle. The postoperative course was long drawn out, but eventually the patient partially recovered.
A. *Anteroposterior Ventriculogram:* Dilatation of the lateral and third ventricles without displacement.
B. *Lateral Ventriculogram:* Extensive dilatation of the lateral ventricles. The posterior clinoid processes are eroded. A portion of the third ventricle can be seen at *a;* the tumor, encroaching upon the third ventricle from below, lies just below *a*.
C. *Lateral Ventriculogram, Midline Body Section Radiograph:* The aqueduct of Sylvius, *b*, is displaced upward and backward. The posterior part of the third ventricle, *a*, is also displaced upward by the tumor, *x*.
D. *Lateral Ventriculogram, Body Section Radiograph, at 1 cm. to the Right of the Midline:* The fourth ventricle, *c*, and lower part of the aqueduct of Sylvius, *b*, are clearly demonstrated. The fact that the aqueduct and fourth ventricles are well seen in this section, taken 1 cm. to the right of the midline, indicates these structures are displaced by the mass away from the midline; otherwise they should be seen clearly in the body-section roentgenogram made through the midline (7C).

MENINGIOMAS OF THE FORAMEN MAGNUM (CLASS V)

The meningiomas in Class V arise from the dura covering the rim of the foramen magnum. They do not include those tumors that pass through the foramen magnum but arise in the spinal dura or in the dura of the posterior fossa.

Occipital and nuchal pain, governing the posture of the head and neck, is the initial symptom. Often its severity is increased by flexion of the neck. However, no clear syndrome can be described.

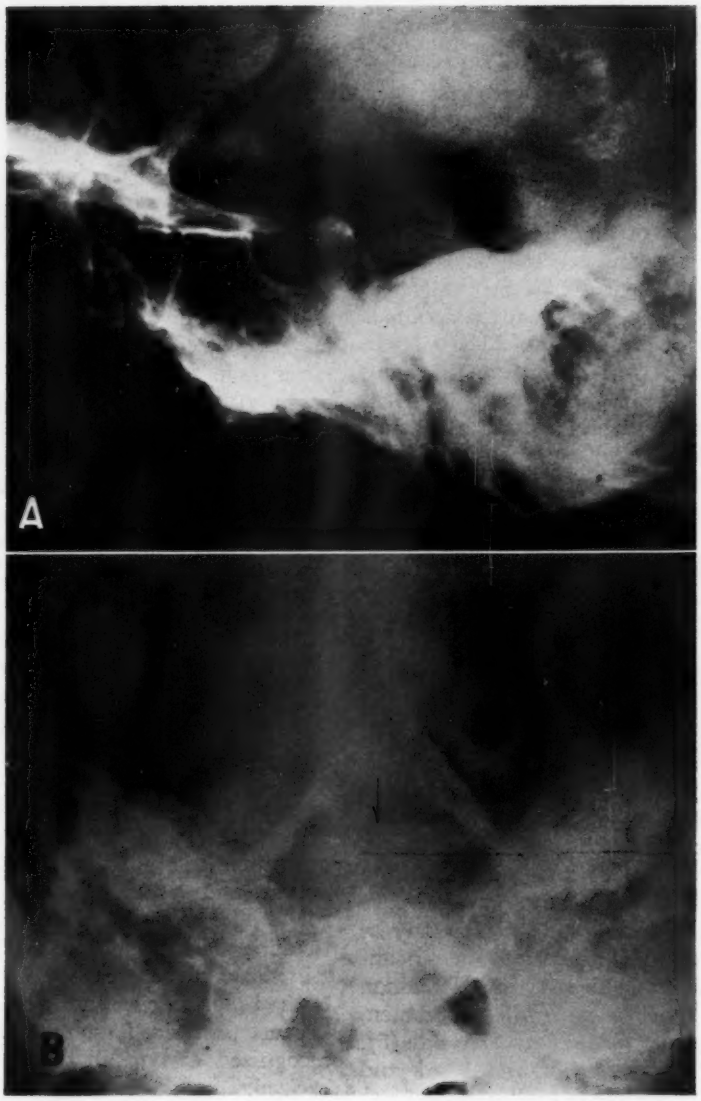


Fig. 8. Meningioma of the clivus.

Clinical History: H. M., a 58-year-old man, had been severely injured in a railroad accident three years prior to admission and had been unconscious for three days. Severe occipital headaches were present from that time until admission for dizziness, blurring of vision, and blindness of six months duration. Six weeks before entry into the hospital, he became paralyzed from the waist down. Clinical findings included a right pupil larger than the left and bilateral papilledema more pronounced on the right. There was gross impairment of hearing on the right and a left-sided Babinsky reflex. The Romberg sign was positive, with backward staggering to the left. A lesion below the base of the brain was partly removed at suboccipital craniectomy. Considerable bleeding occurred, and the patient died with evidence of brain stem damage seven months after operation.

A. *Lateral Projection:* The dorsum sellae and clivus are unusually dense.

B. *Anteroposterior Projection:* The eburnated dorsum sellae is projected into the foramen magnum at the arrow.

Pain, vague complaints of stiff neck, and postural peculiarities are common and are difficult to evaluate (3–6, 9, 11, 26, 27, 35, 37, 42, 46). The intermittent remission of symptoms, often prolonged and even complete, together with the scattered evidence of involvement of the central nervous system further contributes to the confusion (35). Motor symptoms, especially weakness of the upper arms and hands without sensory loss, can occur, since the first cervical root may have no dorsal component. Eventually a "cranial-spinal" syndrome supervenes (35). There may be paresis of a hemidiaphragm; paralysis of extremities and cervical muscles with associated rigidity; hemiplegia, triplegia and tetraplegia; hemianesthesia or paresthesia reaching up to the cervical dermatomes; sphincteric disturbances; Horner's syndrome; signs of increased intracranial pressure, such as papilledema; and paresis of the last four cranial nerves, singly or in combination (5, 35, 40).

Indeed, Castellano and Ruggiero have said: "The possibility of a meningioma of the posterior fossa should always be considered in the presence of a capricious clinical history with long remissions and 'illogicalness.'"

Pathologically, these tumors are surprisingly large, global in shape, and with a tendency to be avascular. Growth above and below the level of the foramen may be equal. Location of the tumor in an anterior site of attachment is more common and the lesion occurs more often in women, typically midway in the fourth decade (5).

Routine radiographs of the head and cervical vertebrae usually fail to reveal any significantly dependable abnormality, although minor asymmetry in configuration and density of the foramen magnum has been recorded.

Cervical myelography has been of limited value. Other authors have been misled by oil opaque studies, which falsely demonstrated tumors in the lower cervical cord when the lesion lay at the level of the foramen magnum.

Pneumoencephalography, with the severe hazard of bulbar failure following herniation of the brain stem, has usually been undertaken when this lesion was not suspected (35). It would appear that ventriculography, when the diagnosis is suspected, would be the procedure of choice; yet deaths have followed any disturbance in the pressure equilibrium (5, 38). The suggestion has been made that air be injected into the lumbar sac without removal of fluid. With the patient sitting erect, only a few cubic centimeters of air may suffice to demonstrate the lower pole of a growth at the foramen magnum (5). The injected air tends to assume a posterior position in the spinal canal. The more common anterior meningioma may thus be missed; encroachment upon the cisterna magna by the displaced spinal cord may reveal the presence of the tumor.

SUMMARY

Meningiomas arising from the dura in the region of the posterior cranial fossa are classified into the five major groups described by Castellano and Ruggiero.

A high index of suspicion for the presence of these lesions is of paramount importance because the subjective and objective complaints include all known combinations of symptoms involving the cerebellum, cranial nerves, and superior cervical spinal nerve roots. These nonspecific complaints, particularly diffuse suboccipital headache and stiff neck, place great responsibility upon both the clinician and the radiologist, because posterior fossa meningiomas, when recognized early, can often be surgically excised.

The major clinical characteristics of the five classes of meningiomas are briefly reviewed. Some of the radiographic changes are illustrated to show that, unless the radiologist is thoroughly aware of the roentgen manifestations of these tumors, an operable lesion may go unrecognized.

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SUMMARIO IN INTERLINGUA

Meningiomas Del Fossa Cranial Posterior

Meningiomas a origine in le dur-matre in le region del fossa cranial posterior es classificate in cinque gruppos principal secundo le suggestion de Castellano e Ruggiero: (1) Meningoimas del convexitate cerebellar; (2) meningiomas del tentorio del cerebello; (3) meningiomas del superficie posterior del portion petrose del osso temporal; (4) meningiomas del clivo; e (5) meningiomas del foramine magne.

Un alte indice de suspicion relative al presentia de iste lesiones es del plus grande importantia, proque le gravamines subjective e objective include omne le cognoscite combinationes de symptomas in cerebello, nervos cranial, e radices nerval del spina cervical superior. Iste nonspecific gravamines—specialmente mal de capite suboccipital e rigiditate del nucha—impone un grande responsabilitate super e clinico e etiam super le radiologo, proque meningiomas del fossa posterior—providite que illos es recognoscite a bon tempore—pote frequentemente esser tractate per excision chirurgic.

Le major characteristicas clinic del cinque classes de meningioma es revidite brevemente. Certes del alterationes radiographic es illustrate pro demonstrar que lesiones que es operabile pote escappar al recognition si le radiologo non es familiar con le manifestationes roentgenologic.

Observations on the Twenty-Four-Hour Pneumoencephalogram with Special Reference to the Diagnosis of Cortical Atrophy[1]

MAX T. SCHNITKER, M.D., F.A.C.S., and ROBERT P. ULRICH, M.D., F.A.C.R.

THERE has been general agreement among radiologists that air in the subdural space, apparent on the pneumoencephalogram, is of no diagnostic or pathologic significance. McConnell (2) of Dublin, however, in 1953 maintained that the demonstration of subdural air over the vertex of the brain in a twenty-four-hour upright film indicated the presence of a subdural fluid collection in cases of the "post-traumatic syndrome" and was the cause of symptoms. Furthermore, he stated that the air reached the subdural space through a tear in the arachnoid membrane produced by a previous head injury. He also suggested that at operation the brain appeared smaller than normal as a result of the fluid compression.

On the basis of these statements, we have been making twenty-four-hour post-pneumoencephalography films in the upright position in all cases subjected to that procedure during the past three years. Pendergrass (4) stated many years ago that the presence of subdural air indicated an error in technic. Paul and Erickson (3), in a review of 78 cases examined roentgenographically twenty-four hours after air injection, found gas in the subdural space in 64 per cent but felt it to be of no diagnostic significance. Similarly, Smith and Crothers (5) emphasized the importance of not interpreting the presence of subdural air in children as an indication of cerebral atrophy or hypoplasia. However, no measurements of brain volume in relation to skull capacity were made in either series, on which to base conclusions. It is our belief that subdural air seen twenty-four hours after pneumoencephalography is a natural sequence, representing neither a technical error nor a pathological lesion.

Since the subdural space can be demonstrated so easily in a twenty-four-hour pneumoencephalogram, it occurred to us that this space might be measured fairly accurately geometrically as a potentially enlarged space between the outer surface of the brain and the inner table of the skull and that such measurements might be an index for establishing the diagnosis of cortical atrophy. Since skulls vary considerably in size and shape, it was felt that the determination of the subdural space as a ratio between subdural air and skull capacity might aid in making a diagnosis of cortical atrophy more accurate.

MATERIAL

This study is based on 66 patients with nonprogressive lesions of the brain who were subjected to pneumoencephalography under Sodium Pentothal anesthesia in the upright position. The fluid-air exchange was done on a volume-for-volume basis until the system was emptied in most instances, the amounts varying from 50 c.c. to 225 c.c. Radiography was done with the patient in the horizontal position, and the usual anteroposterior, posteroanterior, and lateral stereo projections were obtained. In 8 cases, brow-up and/or brow-down lateral films, and in 3 cases anteroposterior films in the upright position, were also obtained. A second set of films—single anteroposterior and lateral upright views—were made twenty-four hours after the first. The tube distance in all cases was 36 inches.

The original pneumoencephalograms were recorded as showing the ventricles well filled or not well filled, normal or dilated. The subarachnoid spaces and cisterns were described as demonstrating average filling, more or less than average, no filling, and cortical atrophy.

[1] From the Departments of Neurosurgery and Radiology, St. Vincent's Hospital, Toledo, Ohio. Presented as part of a Symposium on Neuroradiography at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1956.

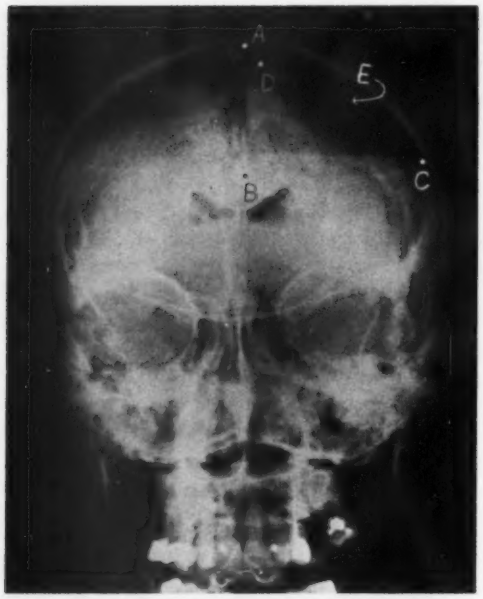


Fig. 1. Twenty-four-hour upright anteroposterior film demonstrating subdural air (E).

The cases were grouped, according to clinical diagnosis, as suspected cerebral atrophy, post-traumatic syndrome, and ordinary headache. No tumors or gross abnormalities were included in the statistical study, but 3 cases of porencephaly and 1 case of hydrocephalus were used, in order to illustrate particular findings. The cases were also divided according to age, ranging from five months to seventy years, with 15 patients under sixteen years (childhood), 13 over sixty (senescent), and 38 between sixteen and sixty years (normal adults).

TECHNIC OF MEASUREMENT

No simple and highly accurate mathematical formula for measuring the volume of subdural air could be devised which would be applicable uniformly to all cases, because of the wide variation in the anatomy and irregularity of the subdural space. A method was used, however, which would determine the amount of subdural air present with a fair degree of accuracy and so permit conclusions of a general nature.

The subdural space in the twenty-four-hour upright anteroposterior film can be visualized as an area between two triangles, one contained within the other, having a common base, the fluid level. Since the area of a triangle is determined by multiplying the height by one-half the base, then the difference between the area of the triangle DBC (brain) in Figure 1, with its apex at the superior medial edge of the hemisphere, and the area of the triangle ABC (skull), with its apex at the inner table of the calvarium at the sagittal suture, represents the area of air in the subdural space. The length of the subdural space is determined by using two-thirds of the length of the air-fluid level as measured in the lateral projection (Fig. 2). The volume of the subdural space is the product of each area determined from the anteroposterior projection multiplied by two-thirds the length determined from the lateral projection. The procedure is repeated for the other side and the sum of the two sides is the total subdural air volume.

In addition to the above measurements, the area of the subdural space (E) in the anteroposterior projection (Fig. 1) was measured directly by finding the average width of the space and multiplying by its length. The subdural volume determined by this method of measurement was somewhat larger than by the triangulation method, although the increase was by a constant factor and the findings were relatively the same for both methods of measurement.

The skull capacity was determined in each instance according to the method of MacKinnon, Kennedy, and Davies (1). In our series the skull capacity in adults ranged from 1,800 to 2,600 c.c., indicating a probable significant variation in both brain volume and the subdural space volume.

MacKinnon, Kennedy, and Davies devised the formula $1/2\ (L\ H\ W) + 1/2\ (L\ B\ W) \times 0.51$ to determine skull capacity, where L represents the internal length or maximum internal anteroposterior diameter; H represents the height measured from the external auditory meatus to the farthest vertical point on the inside of the vault of the skull; B represents the measurement from inside the bregma to the posterior cranial fossa. These three measurements were made on the lateral projection of the skull. In the anteroposterior projection the measurement W was made at the widest part of the calvarium. This formula was combined with the method of subdural air volume determination to find the ratio of subdural air volume to the skull capacity:

$$\frac{\text{Rt. subdural air vol.} + \text{Lt. subdural air vol.}}{1/2\ (L\ H\ W) + 1/2\ (L\ B\ W) \times 0.51} \times 100$$

This ratio is expressed in terms of percentage for sake of convenience.

By using the ratio of subdural air to skull capacity, it was felt that the variation in the size of the subdural space according

to the size of the brain would be eliminated and the resulting figures would be a more accurate representation of the volumetric variations in the brain volume. For example, 28 c.c. of air in the subdural space of a skull with a capacity of 1,800 c.c. would give the same subdural air-skull capacity ratio as 40 c.c. of subdural air in a skull with a capacity of 2,500 c.c. It was also felt that, in using the ratios, rather than the direct measurement figures, variations due to distortion in the radiographic examination would be minimized.

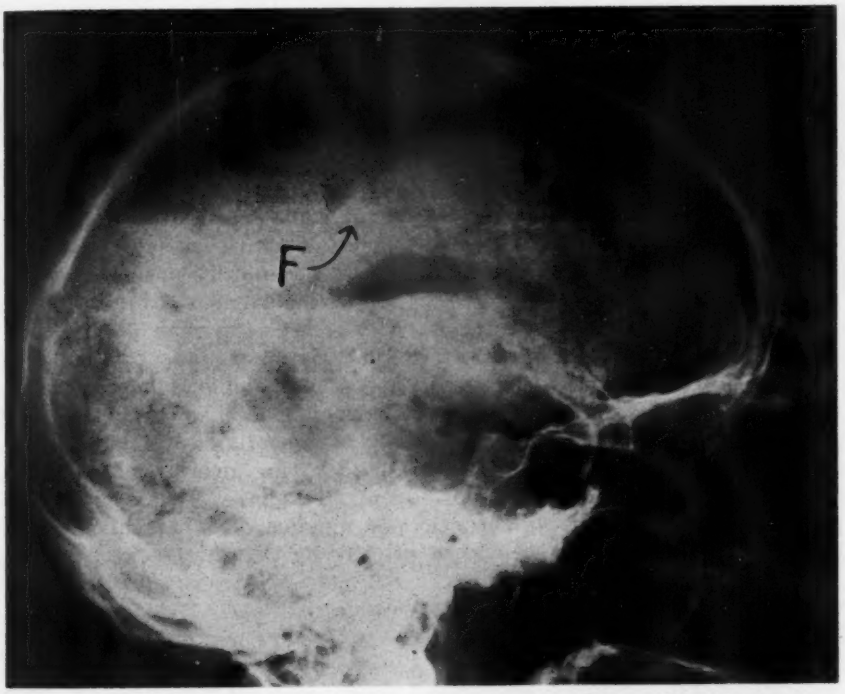


Fig. 2. Twenty-four-hour upright lateral film demonstrating fluid level (F) with air above.

RESULTS

Of the 66 cases, 56 (85 per cent) showed definite evidence of subdural air in the twenty-four-hour film, with a well defined air-fluid level (Figs. 1 and 2). Of the patients over sixteen years of age, 90 per cent showed subdural air and 10 per cent did not. Of children under sixteen years, only 10 (66 per cent) showed subdural air. Four of ten patients without subdural air filling had dilated ventricles. In 1 case of porencephaly no subdural air was visible (Fig. 3). Among 5 adults without subdural air, 2 showed no subarachnoid air on the routine pneumoencephalographic examination; 1 of these had a history of encephalitis four years prior to the examination. Two other cases represent two examinations on the same patient made eighteen months apart.

In 29 cases the subdural air was distributed unequally over the hemispheres; in 11 cases it was unilateral only and in 18 cases there was twice as much air on one side as on the other (Fig. 4). This bore no relationship to the uniform distribution of air in the original pneumoencephalogram. In several patients with porencephaly, symmetrically distributed air was observed in the later subdural air study. Similarly several patients with localized cortical atrophy recognized on the basis of subarachnoid air exhibited symmetrical subdural air later (Fig. 5). It is felt that

TABLE I: SUBDURAL AIR-SKULL CAPACITY RATIOS IN GROUPS STUDIED

	0–16 yr. Normal pneumoencephalogram	16–60 yr. Normal pneumoencephalogram	Over 60 yr. Normal pneumoencephalogram	16–60 yr. Clinically suspected cerebral atrophy	16–60 yr. Evidence of cerebral or cortical atrophy on pneumoencephalogram	16–60 yr. Less than 100 c.c. air exchange	16–60 yr. More than 100 c.c. air exchange
Average ratio for group	0.3%	1.1%	1.8%	1.6%	1.6%	0.6%	1.4%
Range of ratio for individual cases	0 to 0.6%	0 to 2.5%	1.1% to 2.8%	1.0% to 2.4%	1.2% to 2.1%	0 to 1.4%	0.6% to 2.4%

asymmetry of subdural air is due to the position of the patient in bed prior to the taking of the twenty-four-hour film. If he lies on his right side, the air will accumulate over the left hemisphere. It was observed that the ipsilateral ventricle was usually depressed on the side of the subdural air collection (Fig. 4).

The subdural air-skull capacity ratios are shown in Table I. In the childhood group (0–16 years), the subdural air-skull capacity ratios were small in all instances, varying from 0 to 0.6 per cent, with an average of 0.3 per cent in 11 cases having a normal pneumoencephalogram. In 4 patients suspected of having cortical atrophy, the ratio was 0.2 per cent and in another 4 cases with dilated ventricles the ratio was 0.1 per cent. In 1 case of hydrocephalus with marked subarachnoid air filling on the pneumoencephalogram, indicating cortical atrophy, there was very little subdural air on the twenty-four-hour film. Both the individual ratios and the average ratios in this young group were considerably lower than the ratios obtained in the groups over sixteen years of age. It is possible that in the growing brain the potential subdural space available for the accumulation of air is diminished. The reasons for the difference of ratios in the various age groups are not well understood.

In the adult group (sixteen–sixty years) with normal pneumoencephalograms, the average subdural air-skull capacity ratio was 1.1 per cent with a range of individual ratios from 0 to 2.5 per cent. Seven of the 29 patients (25 per cent) had ratios greater than 1.9 per cent. In 9 cases with ventricular dilatation demonstrable on the pneumoencephalogram, the average ratio was 1.5 per cent, with individual ratios between 1.2 and 2.9 per cent, with the exception of a single case with no subdural air. In 13 cases of clinically suspected atrophy in adults, the average ratio was 1.6 per cent, with 3 cases less than 1.0 per cent and 4 additional cases under 2.0 per cent. The appearance of the subarachnoid space on the pneumoencephalogram suggested localized or generalized cortical atrophy in 7 patients having an average ratio of 1.7 per cent. Five cases with a larger than average amount of subarachnoid air demonstrable on the pneumoencephalogram, but not judged to represent atrophy, had an average ratio of 1.1 per cent.

In the senescent group (over sixty years), 4 cases with a normal pneumoencephalogram had an average ratio of 1.8 per cent compared to an average of 1.9 per cent for 7 cases with dilated ventricles. Both the group of 7 cases clinically diagnosed as cerebral atrophy and 3 cases demonstrating probable cortical atrophy on the pneumoencephalogram showed average ratios of 2.0 per cent. In those cases with a normal pneumoencephalogram the ratios ranged from 1.1 to 2.8 per cent. In the presence of ventricular dilatation the range was from 0.7 to 2.8 per cent, and when cerebral atrophy was suggested from 0 to 3.4 per cent. A history of trauma was elicited in 7 cases with an average ratio of 1.2 per cent in a range of 0.6 to 1.9 per cent.

In considering the relationship of air-

fluid exchange to the degree of ventricular filling in 20 adults having normal pneumoencephalograms, it was found that when less than 100 c.c. of air was injected, good ventricular filling was obtained in only 2 of 11 cases, with an average ratio of 0.6 per cent and a range of 0 to 1.4 per cent. When, however, more than 100 c.c. of air was injected (9 cases), the ventricular filling was considered excellent in 6, with an average ratio of 1.4 per cent and a range from 0.6 to 2.5 per cent. It is apparent that the increase in the subdural air-skull capacity ratio can be directly proportional to good ventricular filling. Similar studies of cases with dilated ventricles were not done, since adequate material was not available.

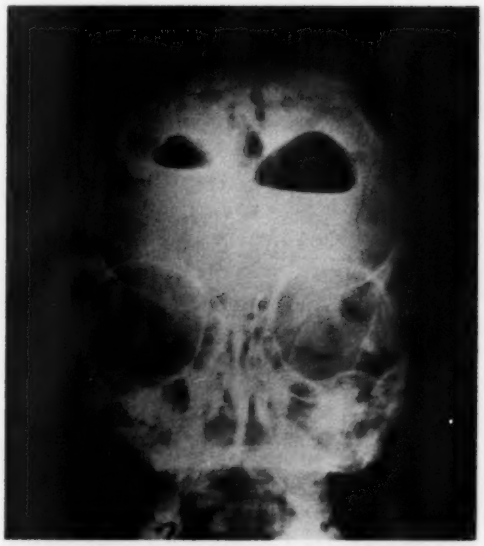
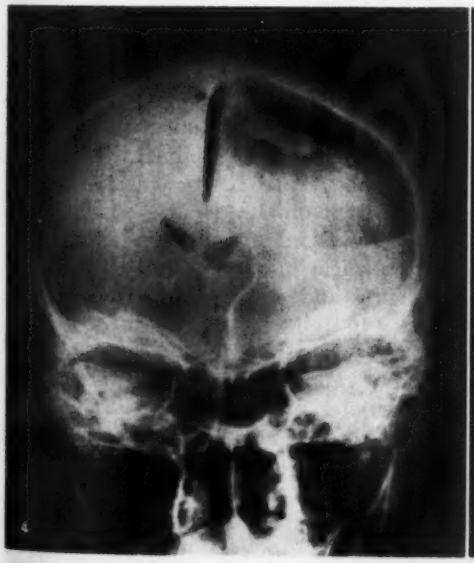


Fig. 3. Twenty-four-hour upright anteroposterior film showing porencephaly and absence of subdural air.

DISCUSSION

In a general review of the series, it was found that the presence of subdural air on the twenty-four-hour film is the rule (90 per cent). Since it occurs so frequently in the cases where the pneumoencephalogram was performed without any difficulty, it is our opinion that it is not due to an error in technic, as first stated by Pendergrass (4), though it may be that in a few cases the air leaks out at the lumbar puncture site into the subdural space. Similarly, since air is so commonly present



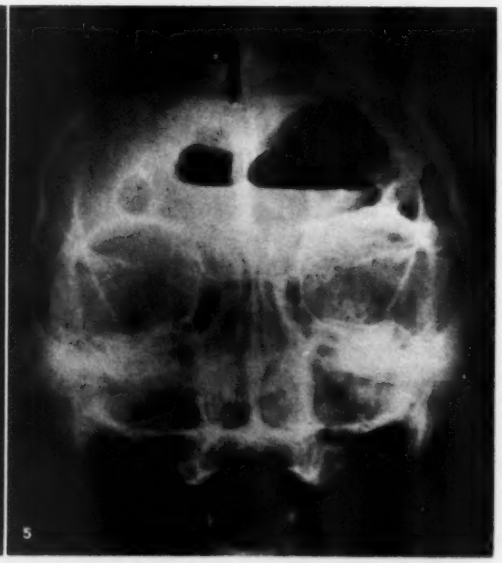


Fig. 4. Twenty-four-hour upright anteroposterior film demonstrating unilateral collection of subdural air that acts like an intracranial mass displacing lesion.

Fig. 5. Twenty-four-hour upright anteroposterior film demonstrating irregular cerebral atrophy but symmetrical subdural air collections.

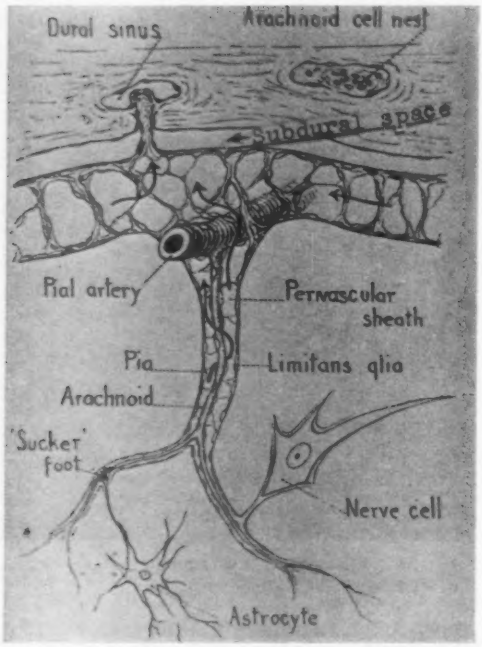


Fig. 6. Diagram to show the relations of the arachnoidal villi crossing the subdural space and the course of the subarachnoid fluid flow. (Modified from Weed. From Cushing, H.: Studies in Intracranial Physiology and Surgery. Cameron Prize Lectures, 1925. London, Oxford University Press, 1926. Fig. 3, p. 19. Reproduced by permission of the publisher.)

subdurally in the absence of any known head injury, and since the arachnoid is known to regenerate rapidly after tearing, we are reluctant to accept McConnell's (2) statement that, "the presence of subdural air in the twenty-four-hour film denotes an antecedent trauma." We can only speculate as to the manner in which air reaches the subdural space when it is injected into the subarachnoid space of the spinal canal. We would suggest that it passes by way of the projections of the pacchionian granulation bodies across the subdural space into the dura at the vertex along the longitudinal sinus (Fig. 6). It is generally agreed that the pacchionian bodies act as the largest system for absorbing cerebrospinal fluid into the systemic circulation. As invaginations of the arachnoid, the pacchionian bodies are covered by the outer layer of the arachnoid and the inner layer of the dura, traversing the subdural space. Since the cerebrospinal fluid is said to traverse these structures by a process of osmosis from the subarachnoid spaces into the venous circulation, it can be hypothesized that air passes from the subarachnoid to the subdural space in a similar manner. It is not known to what degree the air is absorbed and the cerebrospinal fluid simultaneously replaced following pneumoencephalography; it is possible that the air collects near the vertex under pressure of reaccumulating cerebrospinal fluid and hence is forced, under pressure, through the pacchionian bodies into the subdural space before it can be absorbed into the systemic circulation. Stone and Jones (6) proposed a tearing of the arachnoid membrane at the pacchionian granulation to permit the escape of air into the subdural space and then demonstrated this possibility on the cadaver. But such a tear adjacent to or into a pacchionian body proper in the living subject invariably produces bleeding that can be extensive, as observed at the operating table. Intracranial hemorrhage following pneumoencephalography is rare in adults but does occur in children (Smith and Crothers, 5).

From this series it seems very likely that the presence of air and fluid in the subdural space on the twenty-four-hour film does not indicate an abnormality. Indeed, one would rather be inclined to suspect an abnormality when there is an absence of subdural air on the twenty-four-hour film. Only 1 patient, an adult, with a normal pneumoencephalogram showed absence of air and fluid in the subdural space in twenty-four hours. From these observations it is apparent that unilateral cortical atrophy cannot be diagnosed on the basis of a greater amount of subdural air over one cerebral hemisphere. It is also to be noted that, when an asymmetrical accumulation of air in the subdural space displaces the ipsilateral ventricle, the subdural air is in effect acting as a space-occupying mass within the skull.

In considering the various ratios of subdural volume to skull capacity in all three

groups, there was found to be a wide range in the individual cases in each group, except perhaps under the age of sixteen years. Although the average ratios of adults (sixteen to sixty years) fall below 1.7 per cent, many of the individual cases in each group have ratios exceeding 2.0 per cent. For this reason we do not feel able on the basis of this study to establish standard or normal ratios, beyond which pathology or abnormality would be suspected. Regarding the average ratios of the various groups in a more general way, it would appear that the subdural air-capacity ratio tends to be higher in the patients over sixty years, and considerably lower in patients under sixteen years of age. It would also appear that the ratio is dependent, at least in some degree, upon the spinal fluid-air volume exchange and the degree of ventricular filling. This latter finding is more applicable in the presence of a normal pneumoencephalogram than when ventricular dilatation is present. In the light of these studies, cortical atrophy cannot be diagnosed from the twenty-four-hour post-pneumoencephalogram subdural air-skull capacity ratios obtained by our measurements. The diagnosis of cortical atrophy therefore remains presumptive only in the presence of dilated sulci and cisterns and enlarged subarachnoid spaces in the original pneumoencephalogram.

CONCLUSIONS

1. In a series of 66 cases, subdural air was demonstrated in 90 per cent of adults on films made in the upright position twenty-four hours after pneumoencephalography. Subdural air is a natural sequence to the procedure and is not due to an error in technic or necessarily to a tear in the arachnoid membrane.

2. It is suggested that the air from the subarachnoid space reaches the subdural space through the pacchionian granulations that traverse both spaces and that the air is forced through the pacchionian bodies by the pressure of reaccumulating cerebrospinal fluid.

3. A study of the ratios of subdural volume to skull capacity in all age groups showed a wide range of variations both individually and collectively. For this reason it is not felt possible to establish standard or normal ratios, beyond which pathology or abnormality may be said to exist

4. In a general way the subdural air-skull capacity ratios tend to be higher in patients over sixty years of age and considerably lower in patients under sixteen years of age.

5. From these studies it appears that cortical atrophy cannot be diagnosed from the twenty-four-hour post-pneumoencephalogram subdural air-skull capacity ratios.

NOTE: We wish to acknowledge our gratitude to Dr. G. T. Booth, Dr. T. L. Hopple, and Dr. B. B. Shuer for the use of the films of their patients, and to Mr. F. C. Limbert (Ohio Society Professional Engineers) for his technical assistance in compiling the mathematical data.

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(Pro le summario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Observationes Relative Al Pneumoencephalogramma Post Un Intervallo De Vinti-Quatro Horas, Con Referentias Special Al Diagnose De Atrophia Cortical

Le autores obteneva roentgenogrammas in position erecte in un serie de 66 patientes vinti-quatro horas post le effectuation de pneumoencephalographia, con le objectivo de determinar le presentia de aere subdural e su possibile relation a atrophia cortical. Trenta-octo del patientes habeva etates de inter dece-sex e sexanta annos. In iste gruppo de adultos, novanta pro cento monstrava le presentia de aere in le roentgenogramma post un intervallo de vinti-quatro horas. Le occurrentia de tal aere es considerate como un effecto natural del manovra pneumoencephalographic e non como le resultato de un technica defectuose o de un ruptura in le arachnoide, como certe autores lo ha postulate. Il pare que le aere attinge le spatio subdural, post su injection subarachnoide, via le corpores pacchionian le quales illo transversa sub le pression del re-accumulation de fluido cerebrospinal.

Le autores determinava le proportion inter le volumine del aere subdural e le capacitate cranial e trovava extense variationes, tanto inter le gruppos in que le patientes esseva classificate como etiam inter le individuos qui formava ille gruppos. In general, le proportion tendeva a crescer con etates plus avantiate e reducer se in personas de minus que dece-sex annos de etate. Il non esseva possibile establir un proportion critic e asserer que trans illo le presentia de anormalitate esseva indicate. Le diagnose de atrophia cortical super iste base esseva impossibile.

Small Pneumoencephalograms as a Screening Procedure in the Study of Convulsive Disorders[1]

LEWIS E. ETTER, M.D.,[2] and EUGENE L. YOUNGUE, M.D.[3]

Convulsive disorders for definitive diagnosis account for a large number of admissions to the neuropsychiatric hospital from which this report comes. Seizures, whether of the grand mal, petit mal, psychomotor or jacksonian type, may be due to a variety of causes, as expanding lesions such as neoplasms, chronic abscesses, subdural hematomata, cerebral scars resulting from trauma, arachnoiditis from infection, and local cerebral atrophy and cysts. These scars may have resulted from compression ischemia or infection or may be on a congenital basis. Diffuse cerebrovascular disease such as arteriosclerosis and syphilis may also be causative.

Age grouping in a hospital or institution has a considerable effect on the type of lesion one is apt to encounter. Since most of our patients are male veterans in the twenty-to-forty-year bracket, neoplasms, cerebral scars from trauma or infection, and cerebral or cortical atrophy are the more frequent findings. On account of these possibilities, it is obvious that an accurate diagnosis is essential and the function of the x-ray department becomes of paramount importance. With an accurate knowledge of the cause or causes of the disorder, it is often possible for the neurosurgeon or physician to institute corrective measures, surgical or otherwise. Since so much depends upon an accurate radiologic diagnosis, it behooves us to make our examination as complete and exact as possible. Our particular method of procedure will be outlined in detail.

We have been using a small amount of air —routinely 20 c.c.; sometimes 30 c.c.— because of the excellent visualization of the ventricular system obtained by this method and reduction of the unpleasant side-effects often encountered with larger injections. We find air quite suitable and of special value for twenty-four-hour films because it is slowly absorbed and does not disappear with the rapidity of oxygen or other pure gases. For comparison, a number of larger pneumoencephalograms have been made, which will be discussed in detail later.

In Figure 1 is shown a single, short-bevel needle technic for spinal injection of air carried out in the x-ray department by the radiologist or neurologist. A lumbar puncture is made between L-3 and L-4, and 30 c.c. of spinal fluid is gradually withdrawn in 10 c.c. amounts, with fractional replacement by 20 c.c. of air. Erect anteroposterior and lateral films show the fourth ventricle, the aqueduct of Sylvius, the third ventricle, and the lateral ventricles clearly outlined (Figs. 2 and 3).

We believe that for visualization of the fourth ventricle and associated structures it is essential to take erect films immediately after injection of the air, with the patient's head slightly flexed. If additional views of the basal cisterns and third and fourth ventricles are required, these also are taken immediately (Fig. 4). These preliminary films are given a wet reading before proceeding with the examination. Detail screens are used and high-kilovoltage technic, with an additional 3 mm. of aluminum filtration to keep the dosage low. Use of high kilovoltage makes it possible to employ a short exposure even with the 3 mm. of aluminum in the tube head, which is most effective in reducing the dose to the patient.

We use the Franklin head unit for our upright and lateral projections, as well as for brow-up, brow-down, and translateral

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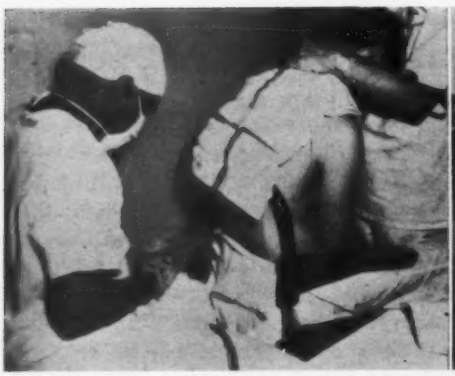

Fig. 1. Single needle between L-3 and L-4 for fractional withdrawal of 30 c.c. of fluid and injection of 20 c.c. of air.

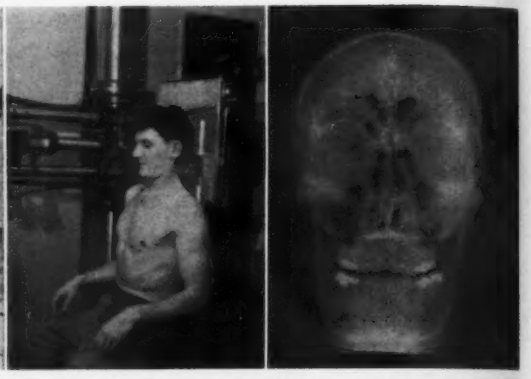

Fig. 2. Immediate anteroposterior erect view of Franklin head unit.

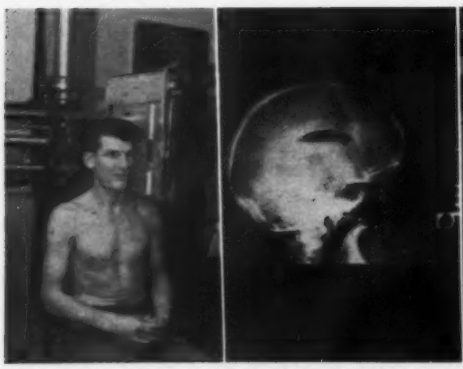

Fig. 3. Immediate erect lateral view for third and fourth ventricle and aqueduct.

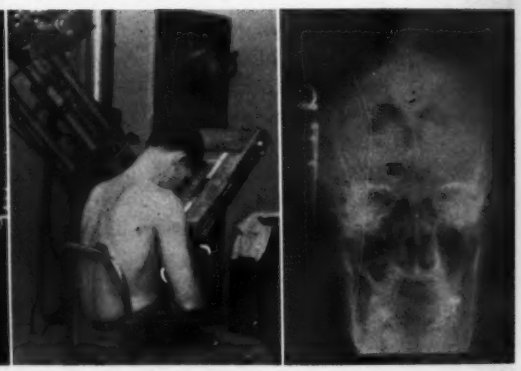

Fig. 4. Postero-anterior oblique view for basal cisterns and fourth ventricle.

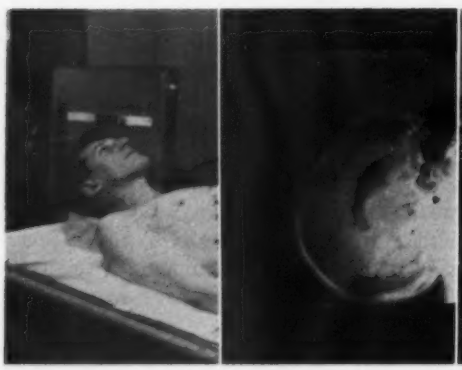

Fig. 5. Brow-up view with patient moved to litter.

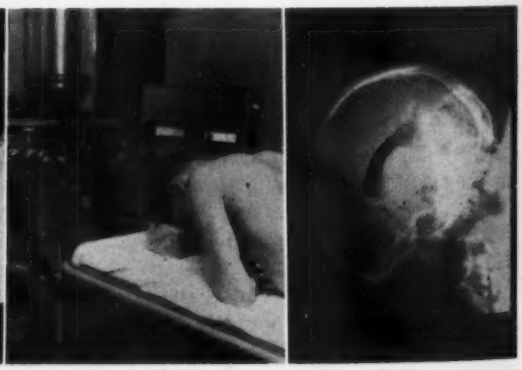

Fig. 6. Brow-down view for posterior horns and fourth ventricle.

decubitus views on the litter. Immediately after the two erect films are taken, they are processed with the patient still in the chair and the needle in place, to be sure we are getting the desired results before proceeding with the remainder of the

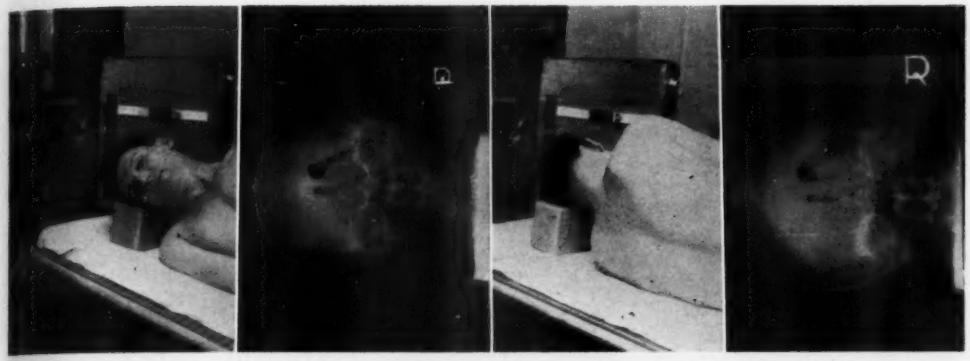

Fig. 7. Right lateral decubitus for left temporal horn.

Fig. 8. Left lateral decubitus for right temporal horn.

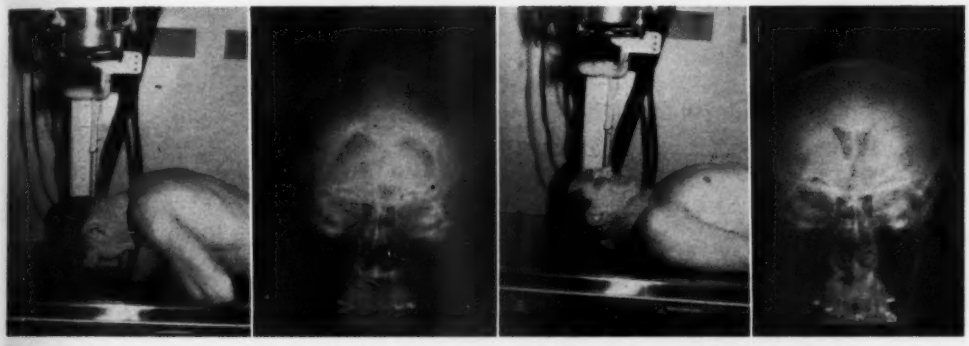

Fig. 9. Postero-anterior prone view on table for posterior two-thirds lateral ventricles and temporal horns.

Fig. 10. Anteroposterior recumbent view on table for anterior two-thirds lateral ventricles and third ventricle.

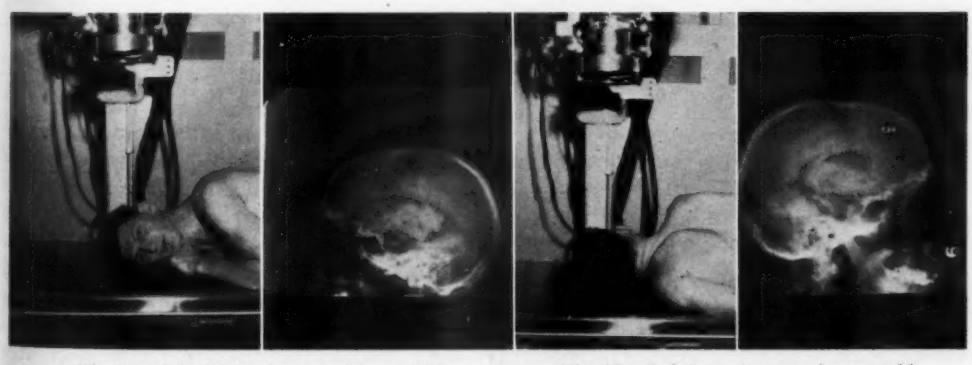

Fig. 11. Right lateral prone view on table.

Fig. 12. Left lateral prone view on table.

examination. It is our practice to process all the films immediately before the patient leaves the department, and to make sure no additional or repeat views are needed.

In the next position (Fig. 5), with the patient on the litter, brow-up and (Fig. 6) brow-down views are obtained. These are made to demonstrate the anterior horns and the aqueduct and fourth ventricle respectively. While still on the litter, the patient is turned on his right and left sides

TABLE I: SERIES OF 211 CASES OF CONVULSIVE AND ALLIED NEUROPSYCHIATRIC DISORDERS IN WHICH SMALL PNEUMOENCEPHALOGRAMS WERE OBTAINED: CLINICAL DIAGNOSES

	Seizures	Multiple and Disseminated Sclerosis	Encephalopathy	Schizophrenia
Number of Cases	108	28	75	28
Normal	36	5	15	16
Abnormal	69*	23	56†	12
History of Trauma	53	3	34	10

*3 Unsatisfactory †4 Unsatisfactory

and anteroposterior and postero-anterior translateral decubitus views (Figs. 7 and 8) are made, especially to show the temporal horns and their relationship to the lateral ventricles. We believe these views at right angles to each other provide more information than stereo pairs.

The next step is to move the patient to the radiographic table for convenience in making the anteroposterior, postero-anterior, and right and left lateral prone views. With the Franklin unit these are difficult to make from the litter, as the patient has to be pulled out over its end. The views obtained on the radiographic table (Figs. 9–12) give supplementary information to be considered in interpreting the entire set of films.

In Table I are presented some statistical data based upon 211 small pneumoencephalograms obtained by us in convulsive and allied neuropsychiatric disorders. The clinical diagnoses in these cases were seizures, multiple and disseminated sclerosis, encephalopathy, and schizophrenia. Encephalopathy is a general term applied to the chronic brain syndrome in persons having arteriosclerotic disease, a history of old injuries, operations, infections, etc.; some of these have had associated convulsive disorders. Cases in which these did not constitute the principal complaint, we have included under the general designation encephalopathy.

Seizures made up the greatest number of cases, followed in order by encephalopathy and multiple and disseminated sclerosis. In 69 of the 108 seizure cases the findings on the 20-c.c. pneumoencephalograms were abnormal and in 36 normal (3 unsatisfactory). In a considerable number of the cases in this group there was a history of trauma. Patients between twenty and forty predominated, partly because this is the age most largely represented in this hospital, but also, we believe, because it is at this time of life that convulsive disorders are most likely to become manifest.

TABLE II: COMPARISON OF DIAGNOSES WITH 211 SMALL AND 189 LARGE PNEUMOENCEPHALOGRAMS ALL NEUROPSYCHIATRIC CASES

	Normal	Abnormal	Atrophy	Cysts	Mass Lesion	Fourth Ventricle Seen	Arachnoiditis	Unsatisfactory
Small, 20–30 c.c.	63	141	137	20	14	190	6	7
	30%	67%	65%	9%	7%	90%	3%	3%
Large, 40–100 c.c.	42	121	121	18	14	142	2	33
	22%	64%	64%	9%	7%	75%	1%	17%

In the multiple and disseminated sclerosis group of 28 patients there were 23 with abnormal pneumoencephalograms and again the greater number of them were between twenty and forty years of age. Of the 75 encephalopathy patients, 56 cases appeared abnormal. Trauma was noted as an important feature in the history, and by far the greater number were in the twenty-to-forty-year age bracket.

In Table II there are presented some comparative data on the 211 small pneumoencephalograms obtained in convulsive and allied neuropsychiatric disorders, including a few psychotic patients, and 189 large pneumoencephalograms of a similar group studied consecutively. We have

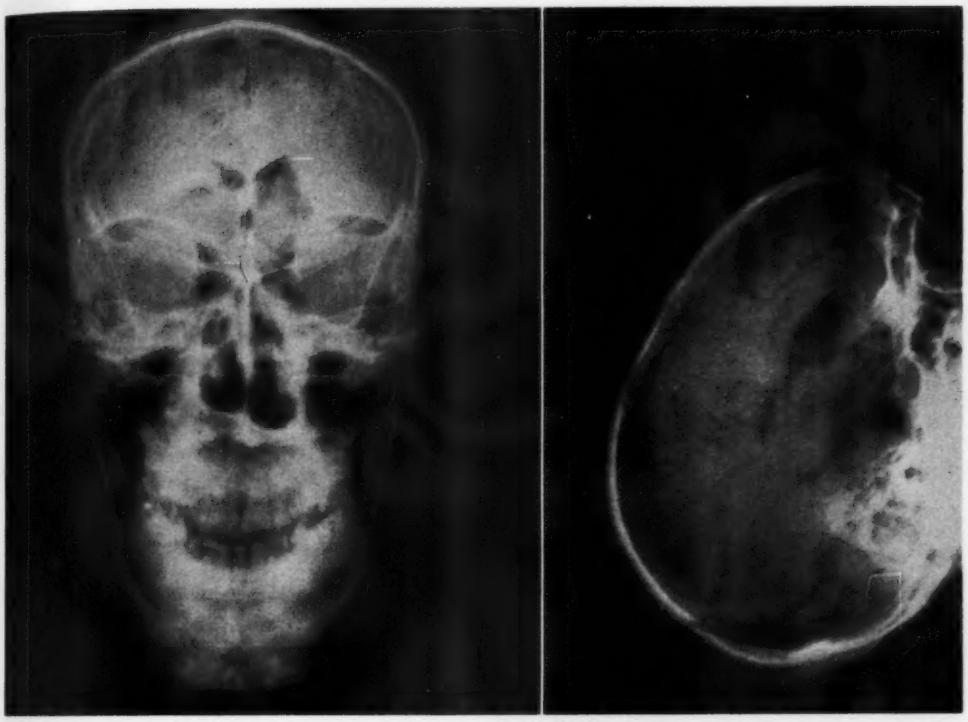

Fig. 13. Pneumoencephalograms made with 20 c.c. of air. Immediate erect and brow-up views, revealing depression of the middle third of the right lateral ventricle from above, suggesting a parietal lobe mass.

TABLE III: COMPARISON OF DIAGNOSES WITH 108 SMALL AND 105 LARGE PNEUMOENCEPHALOGRAMS SEIZURE CASES ONLY

	Normal	Abnormal	Atrophy	Cysts	Mass Lesion	Fourth Ventricle Seen	Arachnoiditis	Unsatisfactory
Small, 20–30 c.c.	36	69	66	8	5	98	4	3
	33%	64%	61%	7%	5%	91%	4%	3%
Large, 40–100 c.c.	29	60	60	7	6	76	1	16
	28%	57%	57%	7%	6%	72%	1%	15%

arbitrarily chosen a figure of 20 to 30 c.c. as representing a small pneumoencephalogram and 40 to 100 c.c. as a large pneumoencephalogram.

From the table, it will be noted that results are roughly comparable in the two series. A larger percentage of fourth ventricle visualization was obtained with the small pneumoencephalograms. This was due, we believe, to the fact that initial films were made promptly after the injection of air so that, with the patient in the erect position with the head flexed, it was trapped at once. The larger amounts of air sometimes progressed farther into the ventricular system before it could be visualized on an erect film. We cannot explain why so high a percentage of the large pneumoencephalograms were unsatisfactory.

Table III compares the results of 108 small and 105 large pneumoencephalograms in seizure cases only. As in the total series, results were roughly comparable. The same explanation for the larger number of visualizations of the fourth ventricle with the small amounts of air is believed to obtain as in the series as a

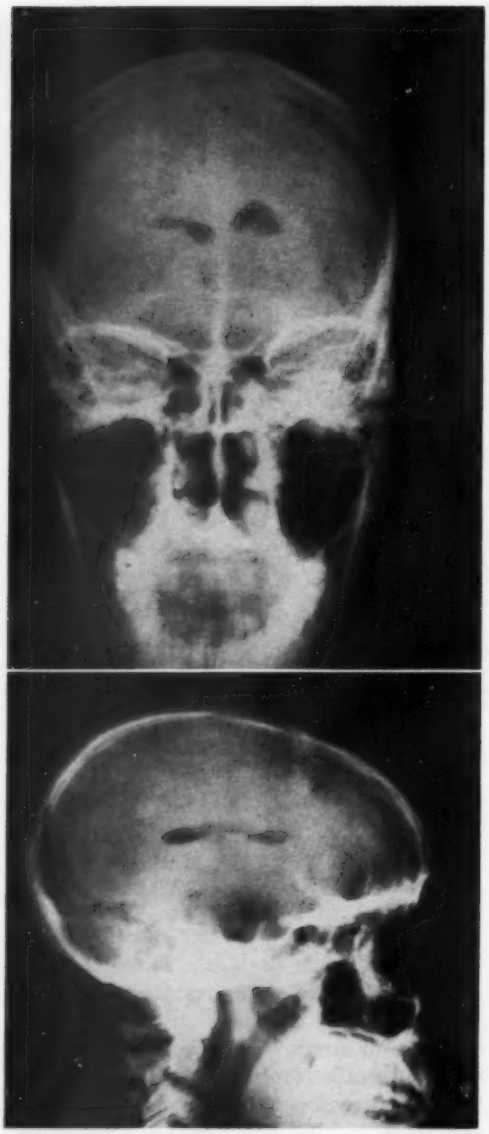

Fig. 14. Twenty-two-hour 20-c.c. pneumoencephalograms, anteroposterior and lateral projections, confirming impression of right parietal lobe mass.

whole, namely that the air was promptly trapped and visualized on the film before it had passed farther into the ventricular system. We are again unable to explain why the percentage of unsatisfactory studies was so much greater when a large amount of air was used.

While it is true that in practically all cases in which pneumoencephalography is done there will be some initial headache as the air passes over the convex surface of the brain and subarachnoid spaces and into the basal cisterns, this usually passes off very promptly when small amounts of air are used. It has been found to be very persistent following larger injections. With these, in addition to the immediate reactions manifested by headache, pallor, sweating, and occasionally syncope, there were persistent headaches lasting for three to seven days, often accompanied by nausea, vomiting, prostration, and lowering of the blood pressure. It is our distinct impression, supported by the figures presented in Table IV, that there is definitely more to be expected in the way of delayed sequelae with larger pneumoencephalograms than with the smaller ones. In this table, based on 400 cases, it will be noted that 72 per cent of the patients having small pneumoencephalograms had an initial immediate reaction of headache or nausea and vomiting while 27 per cent showed a delayed reaction of similar type, possibly with some added prostration and lowering of blood pressure. In the "large" group, 100 per cent exhibited an immediate reaction and 65 per cent delayed reaction, the latter figure being more than twice that for the "small" group, the symptoms usually consisting of headache, nausea, vomiting, pallor, prostration, and lowering of blood pressure which in some cases persisted for three to seven days. When one is dealing with a large hospital population, this consideration becomes important as patients quickly develop a resentment toward the procedure when their fellows discuss the discomfort which they have experienced. If, on the

TABLE IV: COMPARISON OF SEQUELAE WITH 211 SMALL VS. 189 LARGE PNEUMOENCEPHALOGRAMS

	Immediate Reaction	Delayed Reaction
Small, 20–30 c.c.	151 (72%)	57 (27%)
Large, 40–100 c.c.	189 (100%)	122 (65%)

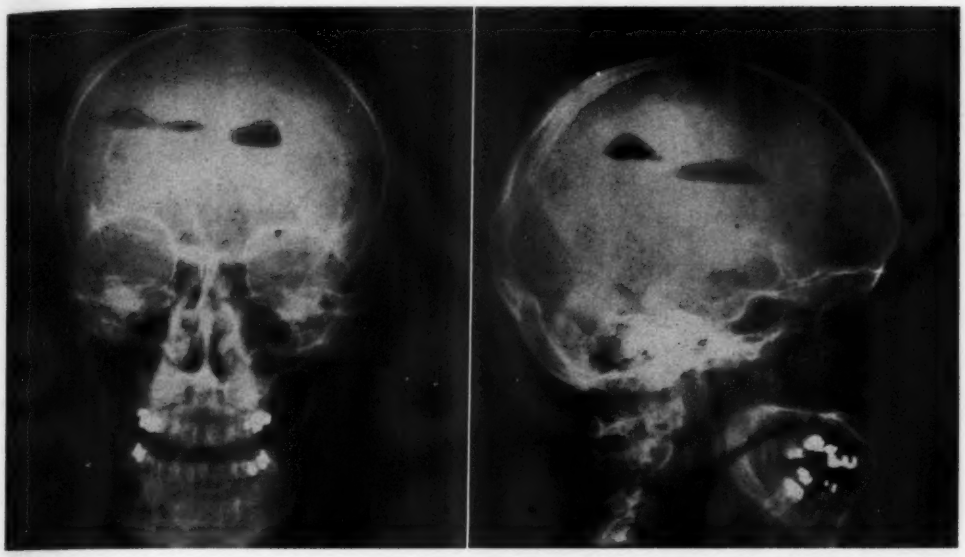

Fig. 15. Twenty-two-hour 20-c.c. pneumoencephalograms, erect anteroposterior and lateral views, revealing extensive porencephalic cystic changes in the posterior superior portion of the right lateral ventricle, extending to the cranial vault.

other hand, only slight or no discomfort is reported, there is then little difficulty in getting patients to submit to this screening procedure. It is our impression that the small pneumoencephalogram in the great majority of cases will furnish equally accurate diagnoses, or at least indication for further diagnostic study, as the larger pneumoencephalogram, and with a minimum of discomfort.

Some of the pathological changes that we have seen on these examinations may be considered in greater detail. As stated above, the changes in the brain in epilepsy are usually related to some postinflammatory process, as meningitis or encephalitis, to head injuries, or to brain tumor.

One patient, a Negro male thirty-one years of age, had experienced intermittent jacksonian seizures for eight or nine years, manifested by shaking and clonic convulsive seizures involving the left arm and leg. There was no definite history of injury. Small (20 c.c.) pneumoencephalograms (Figs. 13 and 14) revealed depression of the middle third of the right lateral ventricle from above, suggesting a parietal lobe mass. At operation this proved to be an angioma in the right superior parietal region.

In a second case, the small pneumoencephalogram revealed definite evidence of a large area of porencephalic cystic degeneration which could be said to be extensive even though the cyst was not completely filled with air. When 20-c.c. pneumoencephalography is done as a routine screening procedure, we are able to pick up any gross abnormality. Should we desire further study, this can be made. In this case the subsequent pneumoencephalogram made with 120 c.c. of air revealed exactly the same features as were seen before, although more spectacularly (Fig. 16). We believe, however, that it is unnecessary to use so large an amount of air in every case since the telltale evidence will be apparent with less.

Another patient was a thirty-two-year-old white male with convulsive seizures and right post-traumatic hemiplegia. A large metallic plate had been fitted over a left parietal and temporal skull defect. The 20-c.c. pneumoencephalogram (Fig. 17) revealed in the twenty-two-hour erect lateral and anteroposterior projections a

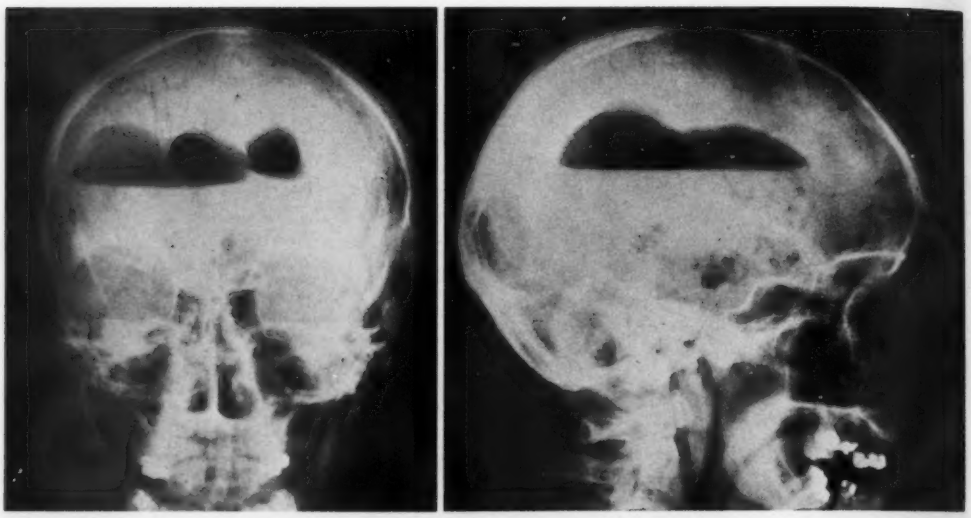

Fig. 16. Erect anteroposterior and lateral 120-c.c. pneumoencephalograms at twenty-two hours, for comparison with Fig. 15. Here the cystic changes in the right lateral ventricle are more dramatically shown, but with no essential change in diagnosis.

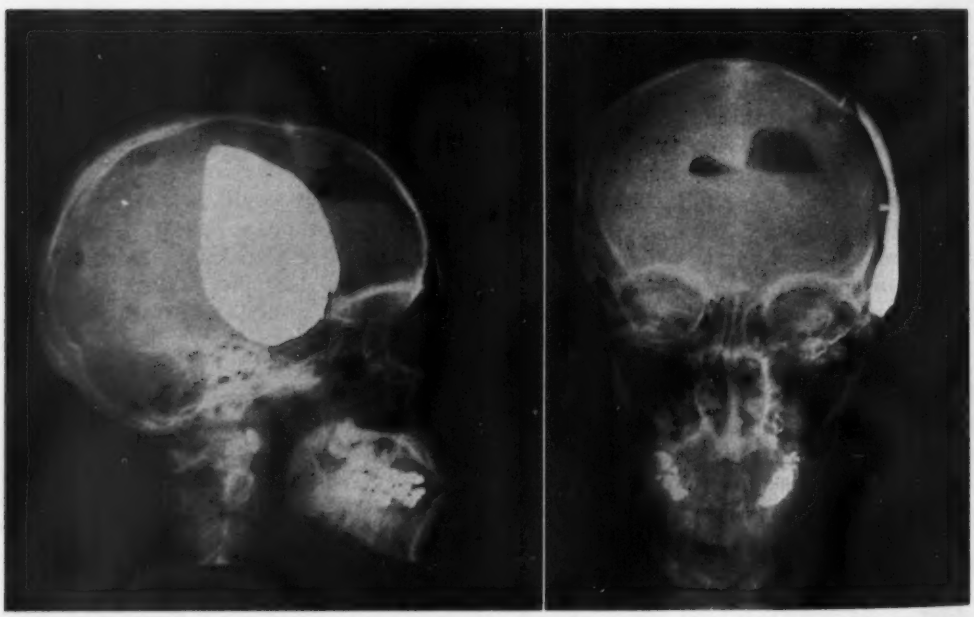

Fig. 17. Twenty-two-hour erect lateral and anteroposterior 20-c.c. pneumoencephalograms revealing porencephalic dilatation of anterior superior portion of the left lateral ventricle.

large porencephalic dilatation of the superior anterior portion of the body of the left lateral ventricle. The brow-up and lateral decubitus views (Fig. 18) showed similar findings, with dilatation of the left temporal horn as well. It was not believed that further study was necessary to explain the convulsions in this case.

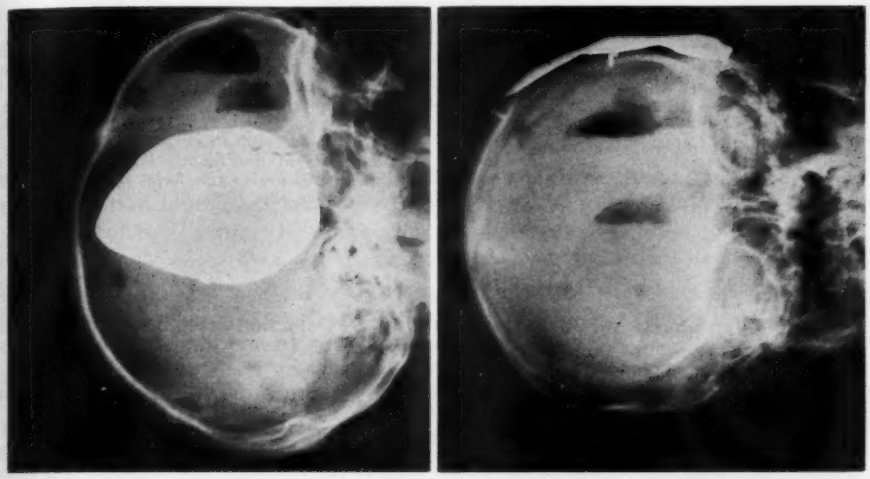

Fig. 18. Brow-up and lateral decubitus 20-c.c. pneumoencephalograms, revealing porencephalic dilatation of the anterior superior portion of the left lateral ventricle and dilatation of the left temporal horn.

SUMMARY

We feel that the small pneumoencephalogram, with 20 or 30 c.c. of air, is adequate as a screening procedure along with the other appropriate neurologic and laboratory tests, where one is dealing with a large number of neurological patients who present the symptom of convulsive seizures. The procedure is safe and may be performed by the radiologist or neurologist in the x-ray department. In a large percentage of cases it is possible to make a definitive diagnosis, or at least to point to the necessity for further study of the patient. There is much less fear on the part of the patients, because of diminished sequelae, and the findings, compared with those on larger pneumoencephalograms, are accurate enough to make it unnecessary to introduce more than 20 or 30 c.c. of air as a routine.

NOTE: We gratefully acknowledge invaluable help, in the preparation of this paper, by Drs. J. C. McClowry and George P. Crump, the x-ray technicians in co-operation with Mr. L. C. Cross, Chief Technician, and our secretaries, Mrs. Gertrude E. Lennon and Mrs. Helen S. McKrell.

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SUMMARIO IN INTERLINGUA

Pneumoencephalogrammas In Micro Como Manovra De Selection Preliminari In Le Studio De Varie Disordines

Pneumoencephalographia con micre quantitates de aere—20 o 30 cm³—se ha provate capace a provider un excellente visualisation del systema ventricular. Le disagradabile effectos lateral—in comparation con le uso de plus grande quantitates de aere (*i.e.*, 40 a 100 cm³)—es diminuite. Pneumoencephalogrammas "in micro" es consequentemente considerate como un adequate manovra de selection preliminari si illo es combinate con altere tests neurologic e laboratorial. Illo se recommenda quando on ha a facer con un grande numero de patientes qui presenta le symptomas de attaccos convulsive. Le technica es salve e pote esser executate per le radiologo in le departimento roentgenologic. In un grande numero de casos iste examine suffice pro establir un diagnose definitive. In altere casos illo da indicationes in re le direction del studio diagnostic additional.

Giant-Cell Tumor of Bone[1]

VERNON R. GEE, M.D.,[2] and DAVID G. PUGH, M.D.[3]

THE PRESENCE of multinucleated giant cells in a variety of bone lesions has led to inclusion of certain neoplastic, inflammatory, developmental, and metabolic disorders of bone under the diagnosis of giant-cell tumor or giant-cell tumor variant. In 1940, Jaffe, Lichtenstein, and Portis (1) offered a specific definition of giant-cell tumor which has gained wide, though not universal, acceptance. They considered it a distinctive neoplasm apparently arising in the nonosteoblastic connective tissue, composed of a vascularized network of spindle-shaped or ovoid stromal cells interspersed with multinuclear giant cells (which they regarded as syncytial stromal cells).

In subsequent publications Jaffe and Lichtenstein (2–6) identified as distinct clinical and pathologic entities many of the lesions formerly classed as giant-cell tumor variants. Accurate identification of lesions in this category is of considerable practical importance. Most of the so-called giant-cell tumor variants are fundamentally benign lesions offering an excellent prognosis, while the true giant-cell tumor is a distinctly more formidable neoplasm. Lichtenstein (7) has stated that approximately half of the proved giant-cell tumors will respond favorably to proper management, approximately a third will prove more aggressive and will recur after treatment, and the remainder ultimately will be frankly malignant.

Changing concepts of the pathology of bone tumors have prompted Dahlin and associates to undertake a comprehensive review of the bone lesions encountered at the Mayo Clinic. Tissues obtained at surgical operation have been subjected to detailed gross and microscopic study, and the lesions have been reclassified in accordance with current concepts. Approximately 5 per cent of the lesions in which material was available for their review were giant-cell tumors.

One practical result of a critical review in the light of changing concepts can be shown by the experience of the Mayo Clinic. In 1932, Kirklin and Moore (8) reported on the roentgenographic appearance of 86 pathologically confirmed giant-cell tumors seen over a twenty-year period. On review, however, only 42 lesions encountered during that period met the revised criteria for the pathologic diagnosis of giant-cell tumor. Some of the lesions originally diagnosed as giant-cell tumor have now been reclassified pathologically as aneurysmal bone cyst, benign chondroblastoma, fibroma, benign giant-cell reparative granuloma, unicameral bone cyst, osteogenic sarcoma, fibrosarcoma, and fibrous dysplasia.

THE CASES STUDIED

Williams, Dahlin, and Ghormley (9) have recently reported on the clinical and pathologic features of the giant-cell tumors observed at the Mayo Clinic. Their report was based on 101 cases seen from 1905 through December 1953. Since that report 1 of the lesions included in the series has been reclassified as an aneurysmal bone cyst and 4 new cases have been added. Thus, a total of 104 lesions meeting current criteria for the pathologic diagnosis of giant-cell tumor of bone has been seen at the Mayo Clinic up to January 1955. These form the basis for this study.

The gross and microscopic features reported by Williams, Dahlin, and Ghormley were in accord with the description

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TABLE I. ANATOMIC DISTRIBUTION OF THE LESIONS

Site	Cases	Roentgenograms Available	
		Pre-treatment	Post-treatment only
Distal part of femur	34	21	7
Proximal part of tibia	22	14	2
Sacrum	10	10	..
Distal part of radius	8	3	5
Distal part of ulna	6	2	..
Proximal part of fibula	6	..	3
Ilium	4	3	..
Distal part of humerus	4	2	2
Distal part of tibia	3	2	1
Proximal part of humerus	2	1	..
Proximal part of femur	1	1	..
Proximal part of ulna	1	1	..
Rib	1	..	1
Tarsal bones	1	1	..
Sphenoid	1	1	..
TOTAL	104	62*	21

* Post-treatment roentgenograms were available also in 42 of these cases.

given by Jaffe and his associates. Lichtenstein suggested a relationship between the microscopic appearance of the individual tumor and its prognosis. Williams and his co-workers noted some variation in the microscopic appearance of the individual lesions in their series but found no consistent correlation between this variation and ultimate behavior of the lesions.

CLINICAL AND ADDITIONAL PATHOLOGIC ASPECTS

Pain was a feature in 98 of the 104 cases in our series, and swelling in 78. A mass was palpable in 88 cases: in 82 of the 87 cases in which tumors involved the extremities and in 6 of the 10 in which they involved the sacrum. Five of the latter were palpable rectally and 1 could be palpated abdominally. A history of trauma was too inconstant to be considered an etiologic factor. Symptoms had been present for periods ranging from a few days to three years.

Since giant-cell tumor is commonly considered as predominantly a disease of young adults, it is noteworthy that approximately a third of the patients in our series were outside this typical age group: 9.6 per cent were less than twenty years old and 24 per cent were more than forty. The youngest patient was twelve years old, and the oldest seventy-one at the time of diagnosis. There were 58 females and 46 males.

The anatomic distribution of the lesions is shown in the accompanying table. Eighty-four per cent of the tumors occurred in long bones of the extremities. It is of interest that 71 per cent of these were adjacent to the knee and 16 per cent were in the distal part of the forearm. These two anatomic regions thus account for 87 per cent of the tumors in long bones.

The absence of the maxilla, mandible, and vertebrae (other than the sacrum) from the list deserves comment in view of the relative frequency of giant-cell tumors in these bones in other reported series. Lesions of the jaws formerly diagnosed giant-cell tumor are now considered to be for the most part benign giant-cell reparative granulomata. Lesions involving various vertebrae earlier classified as giant-cell tumors have been found by the new criteria to be aneurysmal bone cysts or giant osteoid osteomas.

Direct extension of 7 tumors into an adjoining bone was observed roentgenologically. The extension had occurred prior to treatment in 4 cases and with a recurrence of the tumor following treatment in the remaining 3. In 1 additional case, a tumor of the sacrum was found at operation to have invaded the ilium, although this was not apparent on the roentgenogram.

Lichtenstein's estimate of the overall prognosis of giant-cell tumors was supported by the behavior of tumors in this series. Total removal of the tumor (amputation or complete excision of the involved segment of bone) was curative in each instance in which it was undertaken (22 cases). Most of the tumors were treated by curettage, chemical cauterization, and insertion of bone chips into the cavity. Supplementary ionizing radiation therapy was given in about half of these cases. Persistent activity or recurrence

(one or more times), requiring further treatment, was observed in 44 patients (42 per cent). The radiation therapy, as administered, did not reduce the recurrence rate. Radiation alone was successful in controlling several of the recurrences, but was unsuccessful as a means of control in the 12 cases in which it was used as the initial measure.

Histopathologic proof of malignancy was obtained in 9 of our series (9 per cent). In 2 of these, areas of fibrosarcoma were found in otherwise typical giant-cell tumors at the initial examination. In the remaining 7 cases, malignant lesions (fibrosarcoma in 6, osteogenic sarcoma in 1) were demonstrated from four to fourteen years after the original diagnosis of giant-cell tumor. Each of these 7 patients had received radiation therapy prior to the demonstration of malignancy; these have been described in detail by Sabanas and co-workers (10). In 7 additional cases the course of the disease suggested the possibility of malignant transformation. The available information is inadequate, however, to permit any definite conclusion in this regard.

ROENTGENOLOGIC CONSIDERATIONS: HISTORICAL ASPECTS

The first roentgenogram of a bone tumor was published three months after Roentgen announced discovery of the x-rays (11). It showed features subsequently claimed to be typical of giant-cell tumor, although on "superficial" examination it was diagnosed spindle-cell sarcoma. In 1904, Beck (12) described the more pertinent features under the designation myelogenous sarcoma. In 1905, Holland (13) pointed out the lack of specificity of the roentgenologic features. Bythell and Barclay (14) and Scott (15, 16) stated that alterations on the roentgenogram were related more to the growth rate of the tumor than to its specific pathologic type. They noted, for example, that a slowly growing central fibrosarcoma might produce changes suggestive of giant-cell tumor, while a rapidly growing giant-cell tumor might cause considerable osseous destruction lacking distinctive characteristics and resembling changes commonly associated with frankly malignant bone tumors.

Within twenty years of the discovery of roentgen rays, the features considered typical of giant-cell tumor had been described, and attention had been called to the limitations of the roentgenographic appearance as a basis for accurate diagnosis. It is obvious, however, that some of the conclusions reached during that period were based on studies of series including lesions which would not meet current criteria for the pathologic diagnosis of giant-cell tumor. Relatively recently, Brailsford (17) has maintained that the roentgenogram provides a more reliable means for the diagnosis of giant-cell tumors in long bones than microscopic examination of a specimen. Lichtenstein (18) has expressed a directly opposite view. It is our opinion, based on a series meeting Lichtenstein's criteria for the pathologic diagnosis of giant-cell tumor, that the roentgenographic alterations in the long bones are usually suggestive of the nature of this tumor. However, in view of the variation encountered in different tumors in this series, and since other lesions may produce strikingly similar changes, we believe that the roentgenologic appearance is not diagnostic.

The literature on radiation therapy of giant-cell tumors contains divergent views on its merit, and particularly on the dose required to control the tumor effectively. Reliance on the clinical and roentgenologic diagnosis without pathologic confirmation doubtless accounts for some of the conflicting views.

Factors known to modify the roentgenologic appearance are treatment, trauma, and infection. Herendeen (19) described increased osteolysis demonstrable roentgenographically, associated with increased swelling, pain, and redness, reaching a maximum from three to six weeks after radiation therapy and subsiding in about three months. Recognition of this phenomenon (termed "paradoxical reaction" or

"osteolytic thrust") is important, since these rather alarming manifestations suggest rapid progression of the tumor and may lead to unnecessary amputation or over-irradiation. Some have considered this paradoxical reaction a therapeutic test, confirming the diagnosis of giant-cell tumor although critical evaluation of its specificity is lacking. Others regard it as an unnecessary complication which can be avoided by proper selection of dosage and timing of treatments. The other changes following treatment have been described by Brunschwig (20) and Masserini (21). Periosteal reaction, fracture, and calcification within intratumoral hemorrhage have been described as alterations associated with trauma. Reactive osteitis in the surrounding bone has been regarded as a manifestation of infection.

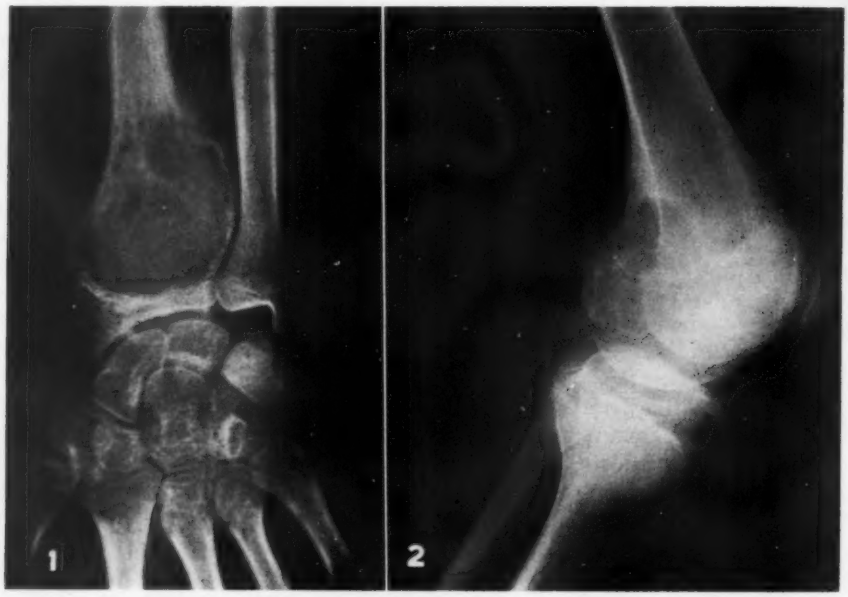

Fig. 1. Giant-cell tumor situated in the distal part of the diaphysis and in the metaphyseal region. The epiphyseal line is intact and the epiphyseal ossification center is not involved. Periosteal reaction is present. There was a history of trauma.
Fig. 2. The area of rarefaction representing the tumor extends across the epiphyseal line to involve the epiphyseal ossification center and the metaphysis simultaneously.

ROENTGENOLOGIC OBSERVATIONS

Roentgenograms obtained prior to institution of any definitive therapy were available for review in 62 cases. In an additional 21 cases post-treatment roentgenograms only were available, since the pathologic material studied included specimens obtained as far back as 1905. The post-treatment roentgenograms were considered in the present study only in determining the relationship of the tumor to the involved bone and in following the changes occurring after therapy. Since there were appreciable differences in the roentgenologic appearance of the tumors in long bones and those in the flat bones, the two categories will be described separately. The tumor tissue itself casts a shadow of the uniform density of soft tissue on the roentgenogram. The alterations to be described are essentially those produced in the affected bone by the tumor (22).

Giant-Cell Tumor in Long Bones: Epiphyseal union had occurred in all but 3 of the 67 cases in which roentgenograms of the affected long bones were available. In 1 of these 3 cases, the

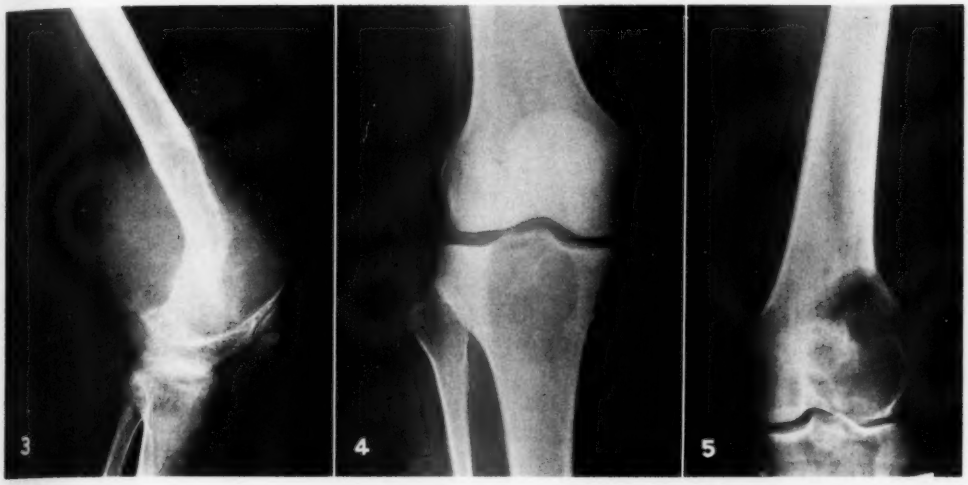

Fig. 3. The soft-tissue density of the tumor is readily apparent, although a bony shell is lacking for the most part. The scattered lines of increased density representing fractional trabeculae are clearly shown. Symptoms attributable to the tumor had been present for one year. The fracture had occurred one month before this roentgenogram was prepared.

Fig. 4. A giant-cell tumor lacking distinctive roentgenologic features aside from its location at the end of the involved bone. This illustrates the variation seen at the margins of the tumor. The medial margin is sharply defined. The lateral margin is less clear-cut but still distinct. The inferior margin is indistinct.

Fig. 5. The so-called typical roentgenographic appearance of giant-cell tumor: a trabeculated, expanding area of rarefaction situated eccentrically in the end of a long bone of a young adult. Slightly less than half of the lesions in the series reported presented this appearance.

lesion was confined to the metaphysis (Fig. 1) and in the other 2 the lesion extended across the epiphyseal plate to involve the epiphyseal ossification center and the metaphysis simultaneously (Fig. 2). In the remaining cases the lesion was located in the end of the bone and with few exceptions (all in the distal part of the femur) extended to the articular cortex, which in several instances was either fractured or eroded. The lesion was situated eccentrically with reference to the long axis of the bone in 78 per cent of the series.

Expansion of the external osseous margin was considered absent or questionable in 23 per cent, slight in 19 per cent, moderate in 41 per cent, and marked in 17 per cent of the cases. The degree of expansion often varied appreciably in different roentgenographic projections.

The peripheral margin of the tumor was usually at least partially encompassed by a thin bony shell. Defects of varying size in this shell, representing erosion or failure of new bone formation by the displaced periosteum to keep pace with expansion of the tumor, were apparent in nearly half of the cases. The incidence of such defects was similar to that reported by Geschickter (23) and Stewart and Richardson (24), but was distinctly higher than implied by most authors. Fractures through the bony shell were visible in several instances.

Where the bony shell was largely absent, the peripheral portion of the tumor presented as a mass having soft-tissue density. In a few cases, widely scattered fine lines of increased density representing fractional trabeculae were projected over this soft-tissue mass (Fig. 3). The internal margin of the tumor was usually represented as in gradual transition from the soft-tissue density to that of the adjoining cancellous bone. The sharpness of this margin varied somewhat from tumor to tumor and also in different portions of the same tumor (Fig. 4). The margin was sufficiently distinct to give one the impression of being able to determine the full

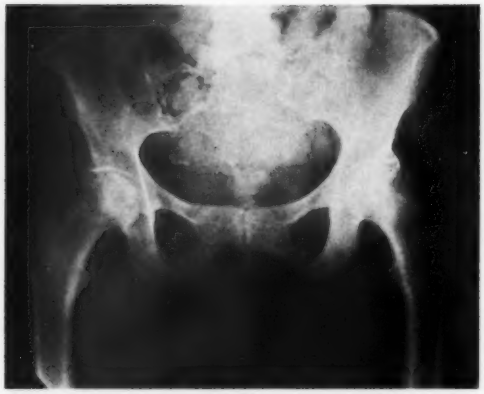

Fig. 6. A trabeculated lesion which has replaced most of the sacrum and extended to the ilia.

extent of the lesion, although in a few instances it was reported by the surgeon to be considerably larger than anticipated on the basis of its roentgenographic appearance. The density was not increased at the margin of any of the untreated tumors. The margin usually formed a smooth curve, although in some cases it was irregular and scalloped.

A trabeculated appearance, due to localized linear areas of thickening in the osseous tissue surrounding the tumor, has received more emphasis than any other roentgenologic feature of giant-cell tumor. The width, number, and distribution of the trabeculae varied appreciably. The trabeculated appearance was, as a rule, more prominent at the peripheral portions of the roentgenographic image (Fig. 5). A prominent trabeculated (or soap-bubble) appearance, often described and illustrated in the literature as being typical of giant-cell tumor, was present in 49 per cent of our cases (23 of the 47 cases in which pretreatment roentgenograms were available). An additional 21 per cent (10 cases) had minimal evidence of trabeculation in some portion of the tumor.

Periosteal reaction was present in 8 cases. It was usually most pronounced in the angle between the normal bone shaft and the outward bulge produced by the tumor. Each of these patients gave a history of trauma, but periosteal reaction independent of trauma has been reported (25).

Subarticular sclerosis, described by Brailsford, was clearly seen in 1 case and questionably present in 2 others. Each of these involved a weight-bearing joint and in each there was evidence of trauma, either in the history or in the presence of fracture. Subcortical sclerosis and reactive osteitis due to infection, also described by Brailsford, were not seen in cases in which treatment had not been given previously. Some degree of osteoporosis of the affected bone or adjacent bones, or both, was evident in more than half the cases.

Giant-Cell Tumor in Flat Bones: The commonest roentgenologic appearance of giant-cell tumor in the flat bones is simply an area of rarefaction lacking in distinguishing characteristics. This has led the more outspoken advocates of roentgenologic diagnosis to concede that there is much less likelihood of correctly diagnosing the lesion in the flat bones than in the long bones.

In view of the striking predilection of giant-cell tumors in the long bones for the end of the bone, it is noteworthy that no such relationship was apparent in the flat bones studied. The sacrum and ilium were the flat bones most commonly involved, and the lesions were found to be fairly evenly distributed in the various portions of these structures.

Expansion was recognized in only a third of the involved flat bones in contrast to about three-fourths of the involved long bones. The problem of detecting and measuring expansion is different, however, in the two types of bones.

A bony shell enclosing the margin of the tumor, which extended beyond the normal bone contour, was demonstrable distinctly less often than in the long bones. When seen, the bony shell was more likely to be incomplete. The internal margin between the tumor and the cancellous structure of the affected bone was essentially as described for the long bones.

A review of the pretreatment roentgenograms in 15 cases of giant-cell tumor

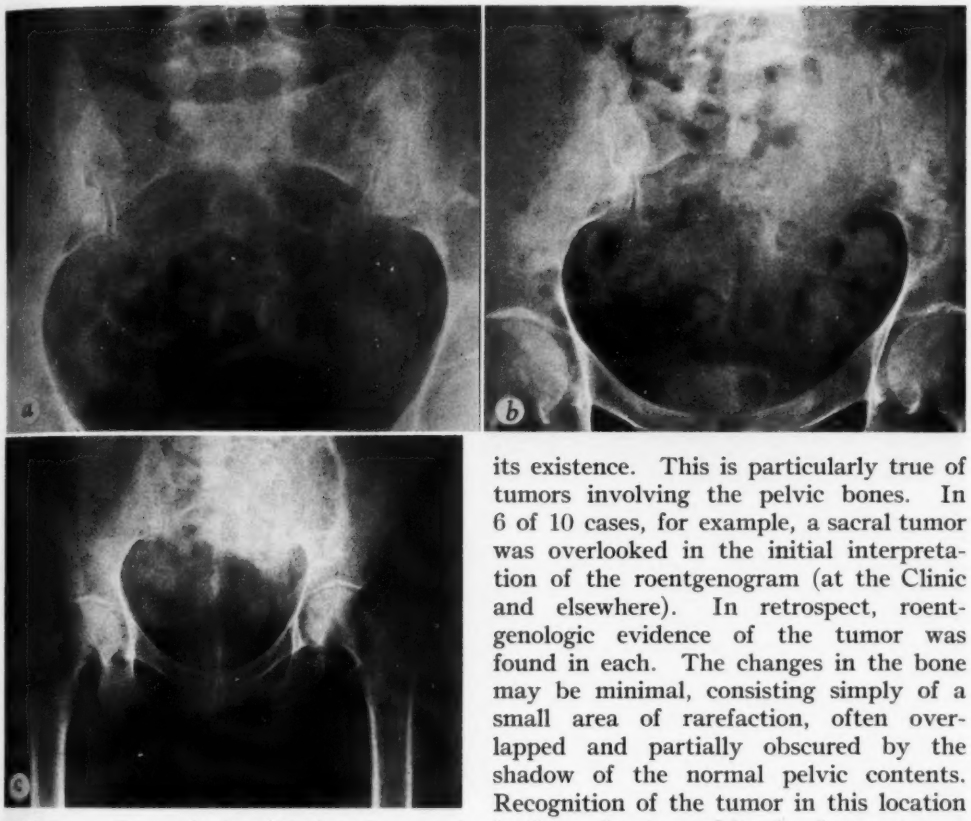

Fig. 7. *a.* The rarefaction of the lateral masses of the first and second sacral segments on the left was overlooked in the original interpretation of the roentgenograms of the lumbar vertebrae. The lesion was first detected at operation, which was performed at that time.

b. Four months later. The destruction of the left upper part of the sacrum and adjoining ilium is readily apparent. Symptoms were those of recurrent tumor. Operation was performed again at this time.

c. Four years later. There is clinical and roentgenologic evidence of healing. Roentgen therapy had been given. There is subluxation at the re-formed sacroiliac joint. (Roentgenogram available through the courtesy of Ralph C. Frank, M.D., Eau Claire, Wis.)

involving various flat bones disclosed only 2 in which trabeculation was prominent (Fig. 6). In 5 others the roentgenograms showed minimal evidence of trabeculation. When present, the trabeculated appearance was distinctly less outstanding than in the long bones.

More important than attempts at correct identification of the lesion roentgenologically is the problem of detecting its existence. This is particularly true of tumors involving the pelvic bones. In 6 of 10 cases, for example, a sacral tumor was overlooked in the initial interpretation of the roentgenogram (at the Clinic and elsewhere). In retrospect, roentgenologic evidence of the tumor was found in each. The changes in the bone may be minimal, consisting simply of a small area of rarefaction, often overlapped and partially obscured by the shadow of the normal pelvic contents. Recognition of the tumor in this location in the early stage of its development may thus be difficult (Fig. 7).

The one giant-cell tumor of the sphenoid bone in our series is of interest because of its unique location. The medial aspect of the anterior clinoid processes had been eroded so that they appeared sharply pointed and rather widely separated. The floor of the sella turcica and the dorsum sellae had been destroyed, and the sphenoid sinus was uniformly opaque. Two tiny curvilinear shadows of calcific density partially outlined the suprasellar portion of the tumor. Thus, the findings were essentially those of an intrasellar tumor, with no indication of its identity.

THE POST-TREATMENT ROENTGENOGRAM

The relative frequency of persistence, recurrence, or malignancy following treatment makes some knowledge of the usual changes particularly important in the

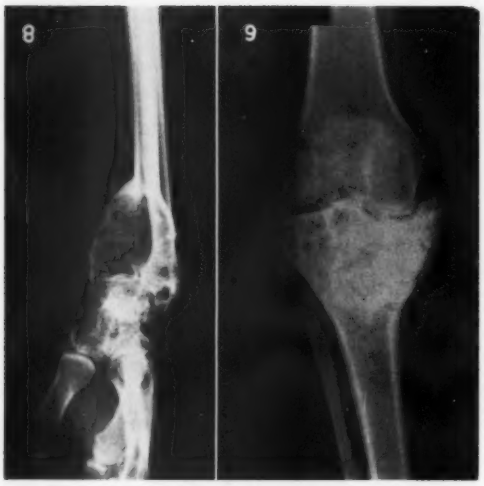

Fig. 8. Formation of a modified ball-and-socket joint at the wrist after treatment. The dorsal and volar expansion of the tumor-bearing radius has partially encompassed the proximal carpal bones. The trabeculated appearance is more distinct than is usually seen in untreated tumors.

Fig. 9. Another instance of formation of a modified ball-and-socket joint many years after the initial treatment. The medial tibial plateau has been depressed and the medial condyle of the femur is partially encompassed by the distorted tibia. Note also the dense sclerosis and absence of a significant pattern in the tumor site.

case of giant-cell tumors. Roentgenograms of the tumor site obtained from one week to thirty-seven years after definitive therapy were studied in 63 cases.

The processes of repair were directed toward the gross and functional restoration of the involved bone. The first indications of repair became apparent from several weeks to many months after treatment. Changes were more rapid during the first year or two, and then slowed until a stable state, with no further change, was reached from five to ten years after treatment.

There was a slow remodeling process directed toward, but seldom achieving, restoration of the normal contour of the bone. The degree of expansion was occasionally somewhat reduced, and there was a definite tendency to smooth any peripheral irregularities. Defects in the bony shell at the periphery were bridged, and in some instances the shell became apparent for the first time.

In 4 cases an alteration in the contour of the articular cortex gradually occurred over a period of several years, resulting finally in a modified ball-and-socket configuration of the joint (Figs. 8 and 9). This phenomenon was independent of weight-bearing, being observed at the wrist as well as the knee.

After treatment, the border between the tumor and cancellous bone was more sharply defined and less irregular, and within a few months the margin of the tumor site usually appeared more dense than the surrounding bone. The trabeculation was increasingly prominent, sometimes becoming evident for the first time. The trabeculae achieved a width and density distinctly beyond those seen in untreated tumors. Over a course of several years, gradual partial or complete obliteration of a recognizable trabecular pattern occurred, resulting eventually in an area of irregularly increased density without a distinctive architectural pattern. Frequently an area of radiolucency of widely varying size and shape persisted indefinitely at some portion of the tumor site.

As noted previously, most of these patients were treated by curettage, cautery, and graft, with or without supplementary radiation therapy. There was no roentgenologic evidence that radiation therapy either accelerated or delayed the repair process. Herendeen's paradoxical reaction (19) was seen only once. It should be remembered, however, that surgery was employed in most cases, and this series must be considered unsuitable for study of that phenomenon.

Persistence of neoplastic activity after treatment was manifested by continued expansion of the tumor and absence of repair phenomena. Recurrence was usually represented by a reversal of the well established repair process, often in only a portion of the tumor site. Sometimes in the later phases, the post-treatment changes were obliterated so that the appearance was that of an untreated tumor (Fig. 10). In the early stages the changes produced by

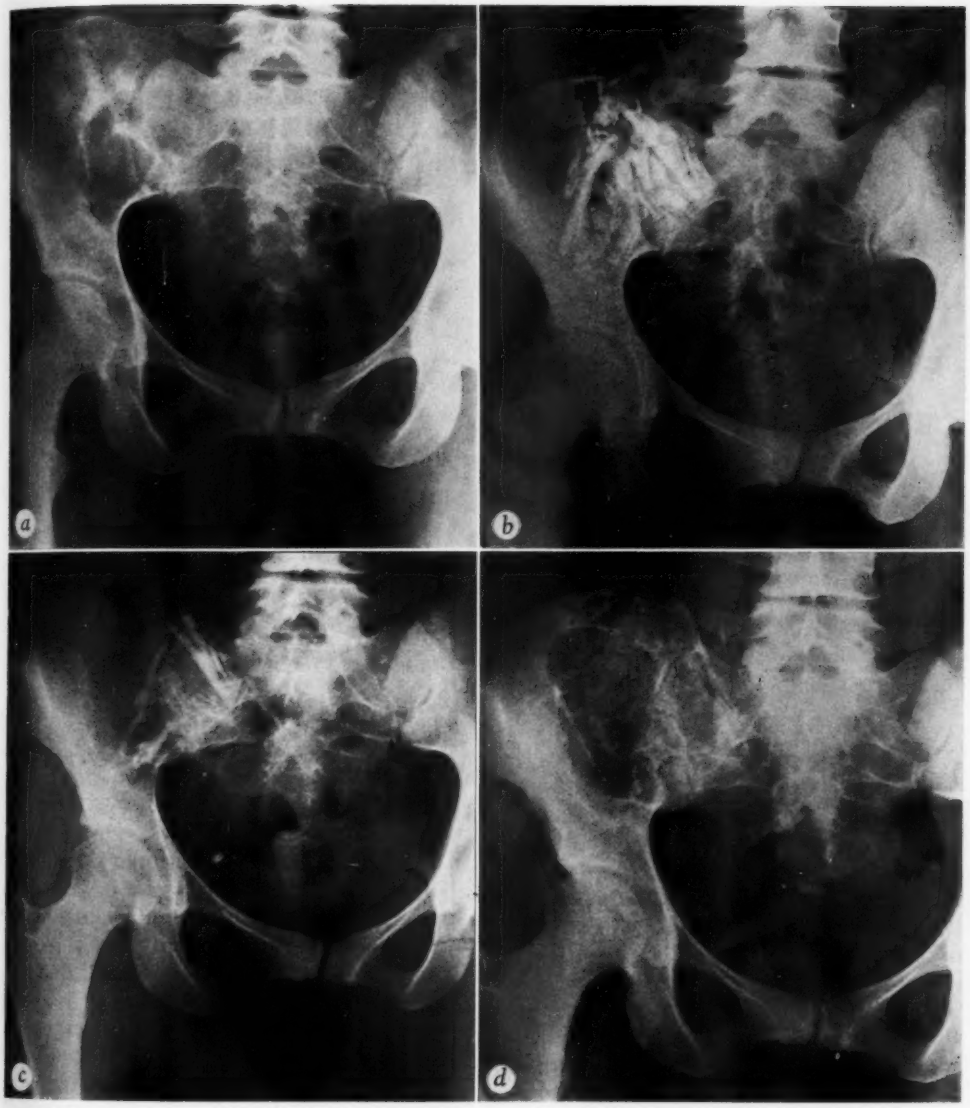

Fig. 10. *a.* Giant-cell tumor of the right ilium. The surgeon noted three distinct though incomplete locules.
b. Appearance following curettage and insertion of bone graft.
c. One year later there was clinical and roentgen evidence of recurrence. The bone grafts have been largely destroyed and the site of the tumor has been enlarged.
d. Appearance six months later, after roentgen therapy. The margin of the tumor is more clearly defined, and regrowth of bone in the site of the tumor is evident.

infection were essentially similar to those of persistent or recurrent tumor, but signs of osteitis appeared later to identify the inflammatory nature of the complication (Fig. 11).

Roentgenograms showing a malignant lesion developing at the site of a giant-cell tumor were available for study in only 3 cases. The earliest changes were indistinguishable from those seen in simple recurrence of the tumor. The late changes were those ordinarily associated with an

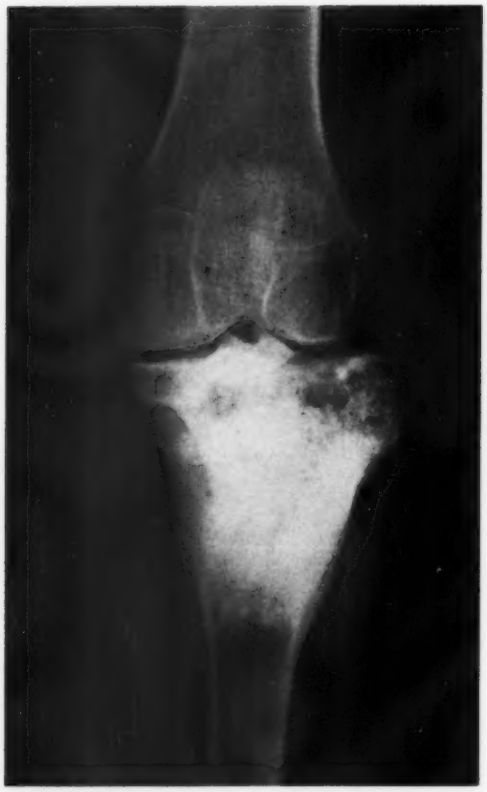

Fig. 11. Reactive osteitis in the bone adjoining the tumor, resulting from chronic infection.

advanced osteolytic malignant tumor of bone and gave no hint of the prior existence of a benign lesion (Fig. 12).

The complications following treatment usually produced roentgenologic signs. For the most part, it was impossible by roentgenologic means alone to distinguish between persistent or recurrent tumor, infection, and malignancy in their early phases. It is worthy of note that 1 patient presented clinical evidence of recurrence following treatment and was shown to have active tumor tissue in the region; yet there was no discernible change in the appearance of the roentgenogram in comparison with one obtained many months before, during an asymptomatic period. On the other hand, in a few cases changes suggesting some complication were observed on the roentgenogram prior to the development of symptoms. These examples make it apparent that careful correlation of the clinical, roentgenologic, and pathologic features is important in the detection, identification, and proper treatment of persistent tumor, recurrent tumor, infection, and the development of malignancy.

COMMENT

It seems logical that the changes seen on the roentgenogram should reflect, at least in part, the growth rate of the tumor. Such a relationship could not be established in this study, possibly because there is no reliable index of the rate of tumor growth. Duration of symptoms is not a suitable index. For example, one patient was told elsewhere that, in retrospect, there was definite evidence of the tumor in roentgenograms obtained for another purpose nine months before the onset of symptoms attributable to its presence. These roentgenograms were not available for review. The tumors in our material which had produced symptoms for the shortest (ten days) and longest (three years) periods of time appeared strikingly similar in the roentgenograms.

As mentioned, Williams, Dahlin, and Ghormley found microscopic study no basis for predicting the future course of an individual tumor. A parallel conclusion was reached in this study. No roentgenologic basis could be established for predicting the future behavior of an individual lesion. A tumor presenting the so-called typical appearance of giant-cell tumor was neither more nor less likely to recur than one presenting a more "active" appearance, that is, extensive destruction of bone, absence of the trabeculated appearance, and an incomplete bony shell at the periphery. Likewise, there was no correlation between the variations in the microscopic appearance and in the roentgenologic appearance.

DIFFERENTIAL DIAGNOSIS

Giant-cell tumor occurring in a flat bone is essentially a destructive process, lacking

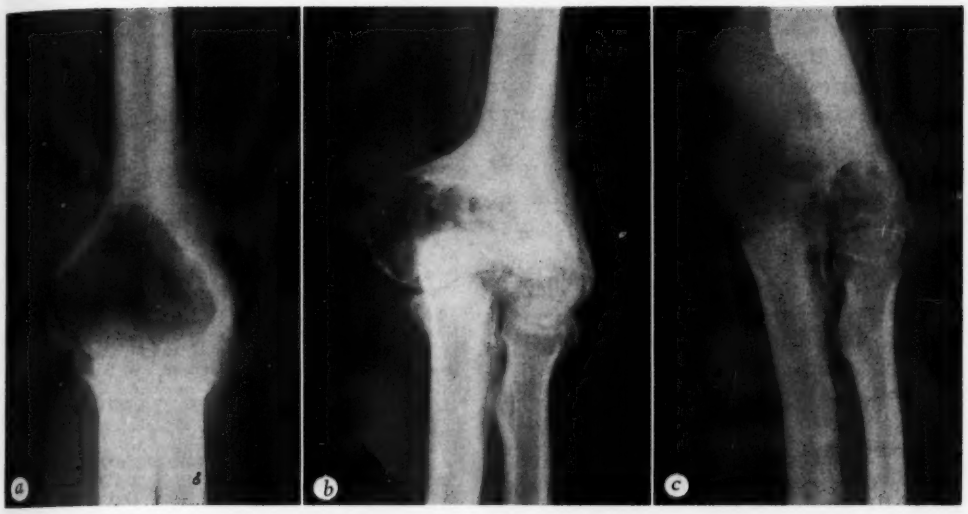

Fig. 12. *a.* Giant-cell tumor before treatment.
b. Three and one-half years later there is clinical evidence suggestive of satisfactory control, but the roentgenogram shows the presence of residual tumor.
c. Eight years after the initial roentgenogram. An osteolytic lesion having the roentgenologic characteristics of a malignant bone tumor has developed at the site of the original tumor. Pathologically it was a typical fibrosarcoma.

in distinguishing characteristics. As a rule, it is impossible to differentiate it from certain other primary and secondary bone neoplasms. A trabeculated appearance is nonspecific, since it may occasionally be produced by other tumors, as, for example, chordoma and myeloma.

Aneurysmal bone cysts (26) cause roentgenologic changes most closely resembling those seen in giant-cell tumor. An identical appearance may be produced by the two lesions. A greater percentage of aneurysmal bone cysts will be seen in patients less than twenty years old, although there is sufficient overlapping of the ages of patients in the two groups to limit the value of this factor. A trabeculated appearance in the roentgenograms is more common and often more prominent in aneurysmal bone cyst than in giant-cell tumor. Occurring predominantly in a younger age group, the aneurysmal cyst is more likely to be observed prior to epiphyseal fusion. In such cases it is situated on the diaphyseal side of the epiphyseal plate and does not cross it.

Benign chondroblastoma (27) likewise is more likely to be encountered in younger patients than giant-cell tumor. It is found with relatively greater frequency in the proximal portions of the humerus and femur. The margin is often indicated by increased bone density rather than decreased density as seen in untreated giant-cell tumors. Vaguely defined calcification is often observed within the tumor. A trabeculated appearance is rare.

Unicameral bone cyst (28) is distinctly more common in a younger group than giant-cell tumor. The majority involve the proximal ends of the humerus and femur, which are relatively uncommon sites for giant-cell tumor. Unicameral bone cyst occurs typically on the diaphyseal side of the unfused epiphyseal line and often, in its later stages, is seen in the diaphysis relatively remote from the epiphyseal line. A sharp line is usually seen at the margin of the cyst. A loculated appearance is common.

Metastatic lesions and certain of the malignant bone tumors, especially in their early stages, may produce areas of destruction closely resembling giant-cell tumors.

SUMMARY

The present report concerns 104 cases meeting current criteria for the pathologic diagnosis of giant-cell tumor of bone, with emphasis on roentgenologic aspects. The pertinent clinical features, the incidence of persistence or recurrence after treatment, and the later development of malignancy were observed in the series.

The so-called typical roentgen picture of giant-cell tumor may be summarized as follows: an expanding area of rarefaction situated eccentrically in the end of a long bone in a young adult. Exceptions to this description, however, were common. Expansion was absent or only questionably present in 23 per cent. The tumor was centrally located within the involved bone in 22 per cent. Nearly 35 per cent of the patients could not be classed as young adults. The most constant element in the above description was the location in the end of the involved bone. A trabeculated appearance was a prominent feature in slightly less than half of the cases.

Giant-cell tumors involving flat bones lack distinguishing radiologic characteristics. Lesions in the pelvic bones are easily obscured and may be difficult to detect.

The lack of correlation of the initial roentgen picture with the course of the disease after treatment and with the variation in microscopic features has been noted.

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SUMMARIO IN INTERLINGUA

Tumores Ossee A Cellulas Gigante

Le presente reporto concerne 104 casos que satisface le criterios currente pro le diagnose pathologic de tumor ossee a cellulas gigante. Attention special es prestate al aspectos roentgenologic. Le pertinente characteristicas clinic, le incidentia de persistentia o recurrentia post le tractamento, e le disveloppamento subsequente de malignitate esseva observate in iste serie.

Le si-appellate typic tableau roentgenologic de tumor a cellulas gigante pote esser summarisate sequentemente: Un area expansive de rarefaction situate eccentricamente al termino de un osso longe de un juvene adulto. Expansion esseva absente o dubitosemente presente in 23 pro cento del casos. Le tumor esseva locate centralmente in le osso afficite in 22 pro cento. Quasi 35 pro cento del patientes non poteva esser classate como juvene adultos. Le plus constante elemento in le supra-presentate description esseva le location in le portion terminal del osso afficite. Un apparentia trabeculate esseva un tracto prominente in levemente plus que un medietate del casos.

Tumores a cellulas gigante que affice ossos platte non possede distincte characteristicas radiologic. Lesiones in le osso pelvic es facilemente obscurate e pote esser difficile a deteger.

Es notate le absentia de correlation del tableau roentgenographic initial con le curso del morbo post le tractamento e con variationes in le aspectos microscopic.

Roentgen Diagnosis of Urinary Complications Following Radical Hysterectomy and Pelvic Lymph Node Dissection[1]

WILLIAM HANAFEE, M.D., RICHARD E. OTTOMAN, M.D., and STEFAN P. WILK, M.D.

WITH THE RENEWED interest in the surgical attack on cancer of the cervix come the inevitable complications which accompany any form of radical therapy. The radiologist must be prepared to assist the surgeon in the diagnosis of post-Wertheim urinary complications, since early recognition of an injury to the urinary tract is not always clinically obvious. Urine may leak from the lower urinary tract for several days before a communication is actually established with the exterior either through the vagina, skin, or rectum. Also, because of interference with the nerve supply, the patient may be unable to distinguish a complicating urinary fistula from a simple incontinence.

This paper will not be concerned with survival percentages or with the conflict of surgery *vs.* radiation therapy in cancer of the cervix. Rather, an attempt will be made to describe the roentgen aspects of complications occurring in the urinary tract following radical hysterectomy (Wertheim), with clinical examples by way of illustration. Major complications are a result of deficient blood supply, with resultant tissue necrosis. In addition, there is some loss of bladder sensation due to altered nerve supply.

An appreciation of the roentgen findings can best be attained by a thorough understanding of the surgical technics, which of necessity diminish the blood supply of remaining pelvic structures and alter their sensation. On this basis, coupled with a background of anatomy, the roentgen findings can be predicted and the time sequence of their possible appearance established.

SURGICAL CONSIDERATIONS

Once the abdomen has been entered, the operation may be divided into three major dissections, which are interrelated but performed in varying sequence by the different surgical groups. (*a*) The uterus and upper vagina must be freed from the bladder and rectum. (*b*) Some type of pelvic lymphadenectomy involving the obturator, hypogastric, and iliac node areas must be done. (*c*) The distal ureter must be mobilized to remove the parametrium and periureteral tissues and associated lymphatic channels.

(*a*) *Freeing the Uterus:* The ovary, if it is to be sacrificed, is mobilized by dividing the infundibulopelvic ligament. The peritoneum is incised anterior and posterior to the round ligament, and the lateral attachment of this ligament is severed. The peritoneal flaps thus obtained are later used to close the operative defect. The peritoneal reflection from the uterus to the bladder is incised and the bladder is dissected free of the cervix and upper vagina. Later in the procedure the uterosacral ligaments will be ligated and the rectum separated from the vagina.

(*b*) *Iliac and Hypogastric, and Obturator Node Dissection:* Individually enlarged nodes may be removed or an incontinuity type of dissection may be performed, consisting of sweeping nodes, perivascular fat, and perivascular tissues from the superior to an inferior position, to be excised later *en bloc* with the upper vagina and uterus.

Since the incontinuity dissection is becoming more popular and is the more difficult, our description will be confined to that technic. The peritoneum is incised lateral to the ureter from the level of the bifurcation of the common iliac artery to the femoral canal. The ureter is gently pulled to the midline with its

[1] Based on an Exhibit at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1956. From the Departments of Radiology, University of California Medical School, Los Angeles, and Harbor General Hospital, Torrance, Calif. Accepted for publication in July 1957.

peritoneal attachment, and the lower common iliac artery and vein are cleared of perivascular tissue and nodes. This dissection is extended down the common iliac and external iliac vessels to the femoral canal. The obturator fossa lies lateral to the external iliac vessels and is cleaned out with sharp dissection by retracting the external iliac vessels anteriorly and laterally.

Attention is then directed to the internal iliac (hypogastric) and periureteral tissues. Areolar tissues and lymphatics are cleaned off the lateral pelvic wall and proximal portion of the internal iliac (hypogastric) vessels. The superior vesical artery is ligated. The parametria are then detached from the floor and lateral wall of the pelvis. The uterine artery thus exposed is ligated at its origin. The ureter derives a branch from the uterine artery, and this branch is of necessity sacrificed. Another artery to the low ureter occasionally arises directly from the internal iliac artery and, if present, is preserved.

The very vascular perivesical and perivaginal tissues are swept to the midline.

The uterus is then separated from the rectum, after incision of the peritoneum and ligation of the uterosacral ligaments. The middle hemorrhoidal and inferior vesical arteries are usually ligated during this dissection.

(*c*) *Removal of Parametrium and Periureteral Tissues:* With the uterus partially freed, the periureteral tissues are carefully teased from the ureter. This is the crucial phase of the operation, since the vascular supply of the ureter has already been compromised by ligating the uterine and superior vesical arteries and is dependent on the vertical anastomoses in the periureteral fascia and wall of the ureter. Since the lymphatics from the cervix also traverse this fascial sheath in their course to the lateral pelvic wall, the possible advantage of a radical operation cannot be nullified by leaving behind any potentially cancer-bearing tissue. The periureteral tissue must be removed by a dissection which is begun superiorly and extended inferiorly to the entrance of the ureter into the bladder wall.

The vagina is freed further from the bladder and rectum. A clamp can then be placed across the vagina and it is transected. The entire mass of uterus, upper vagina, tubes, ovaries, and parametrial tissue and perivascular tissues can then be removed *en bloc*.

The presacral area is cleared of nodes, with care not to remove the presacral nerves. The peritoneum and vagina are then closed after a wick has been placed in the vagina for drainage.

ANATOMICAL CONSIDERATIONS

Arterial Blood Supply: The major postoperative complications are due to deficient blood supply with resultant necrosis. Thus, knowing what arteries are ligated and what vital structures they supply, one can predict where vascular insufficiency may become manifest. The large arteries which may be ligated are as follows: the superior vesical, which supplies the dome of the bladder and distal ureter; the uterine artery, which sends a branch to the ureter besides supplying the genital structures; the inferior vesical, which courses along the floor of the pelvis to the base of the bladder and anastomoses in order to further supply the distal end of the ureter; the middle hemorrhoidal, which also contributes to the collaterals about the distal ureter.

It will be immediately noticed that *all of the vessels which are ligated contribute branches to the distal 6 cm. of the ureter and to the posterior, inferior, and lateral portions of the bladder.* Fortunately, the branches of vessels supplying the ureter pass vertically in the wall of the ureter and have a rich anastomosis. Necrosis will take place in only 9 to 17 per cent of the cases (9, 15, 24) and then is directly proportional to the extent of removal of the periureteral tissues containing the collateral vessels. A good therapeutic result, however, is contingent on removal of all potential cancer-containing lymphatics in these same tissues.

TABLE I: ANATOMICAL BASIS FOR COMPLICATIONS FOLLOWING HYSTERECTOMY

	Immediate	Delayed
1. Bladder fistula	Tears during surgical dissection	Necrosis due to ligation of superior vesical and inferior vesical arteries
2. Bladder neurogenic disturbances		
A. Atonicity	Damaged musculature plus severed sympathetics and parasympathetics	Incomplete emptying of bladder due to lack of parasympathetic regeneration
B. Incontinence	Damage to pudendal nerve	
C. Sensation loss	Damage to pelvic nerves (S 3 and 4)	
3. Ureteral injuries		
A. Fistula	Surgical accident (rare)	Necrosis in seven to ten days due to ligation of uterine and superior vesical arteries, branches from inferior vesical, and branches from middle hemorrhoidal
B. Stricture and obstruction	Surgical ligature or clamp placed on ureter (rare)	Scarring due to trauma from removal of periureteral sheath

Nerve Supply and Action: The sympathetic nerves to the ureter exert a motor effect and arise from the renal, ovarian, and hypogastric plexuses. Parasympathetic nerves have not been demonstrated anatomically, but a parasympathetic effect can be elicited with parasympathomimetic drugs. These nerves follow the sheaths about the corresponding arteries. The interference with efferent motor nerves, together with local trauma and edema, partially explains the early postoperative hydroureters and hydronephroses.

The nerve supply to the bladder is more complex, consisting of two motor systems and one sensory system. Micturition can be partially controlled voluntarily by contracting or relaxing the external sphincter and by changing intra-abdominal pressure. The involuntary mechanism of micturition is under the influence of the autonomic system, made up of the sympathetic and parasympathetic nerves. The sympathetics cause relaxation of the bladder and contraction of the internal sphincter, while the parasympathetics cause contraction of the bladder and relaxation of the internal sphincter, thus tending to exert opposing actions. The balance thus achieved serves to give tone to the bladder. The nerve fibers follow the arteries to the bladder.

The afferent fibers, or sensory fibers, are contained in the pelvic and hypogastric nerves. We are more primarily concerned with those transmitting the sensation of filling of the bladder, since this sense is frequently lost in the early postoperative period.

Anatomical Considerations Predisposing to Surgical Accidents: Because of the extensive venous plexuses in the subvesical and paravaginal areas, bleeding can easily occur, with staining of the operative field. Also, excessive bleeding may be encountered if one is forced to remove the external iliac vein. The blood loss itself can be easily stopped by packing with Gelfoam gauze, and blood replacement is no problem. The only danger is injury to vital structures, as the ureter or bladder, in the course of locating, clamping, and tying the bleeding vessels.

The line of cleavage between the floor of the bladder and vagina is indistinct because the smooth muscle fibers intermingle to a certain extent. It is easy to understand how, if one is operating in a blood-stained field or even under well controlled conditions, the bladder could be entered inadvertently. Such rents are readily recognized and can be repaired immediately.

DISCUSSION

In view of the technical aspects of radical hysterectomy with pelvic lymphadenectomy, it becomes obvious that the

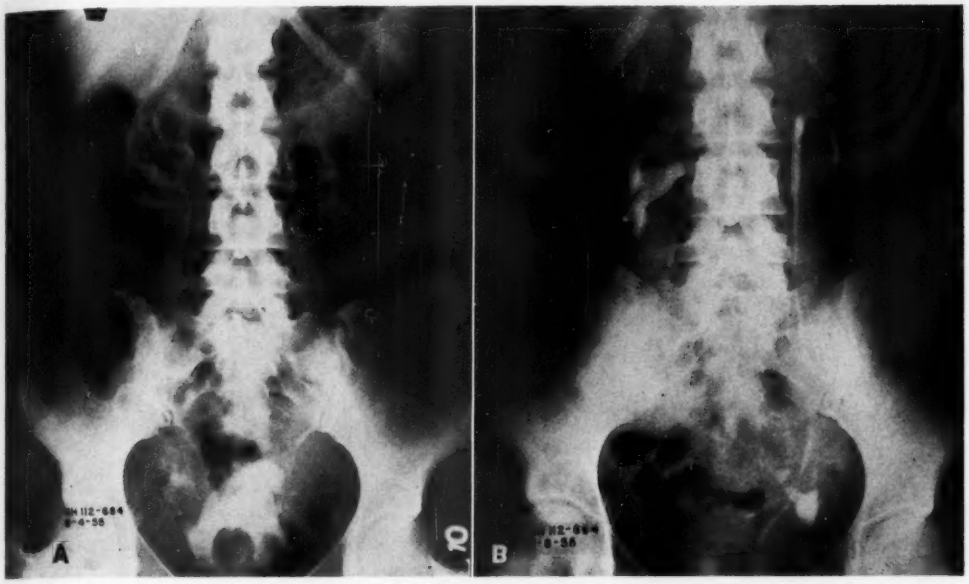

Fig. 1. Case I. A. Twenty-five days following operation. Bilateral, hazy outline of the ureteral fistulous tracts and "Christmas tree" bladder.
B. Ninety days postoperative. The right fistula has healed spontaneously, but the left is sharply outlined by a well formed tract.

TABLE II: ROENTGEN FINDINGS IN COMPLICATIONS FOLLOWING HYSTERECTOMY

	Bladder	Ureters	Kidneys
Early	Smooth dilatation or "Christmas tree" effect. Residual medium after voiding. Inverted tear-drop shape	Proximal dilatation and distal narrowing. Urine extravasation, as a faintly outlined pocket	Decreased concentration power
Late	Residual urine and vesicovaginal fistula. Best seen on cystogram	Stricture or ureterovaginal fistula. Fistula may be hazy or become a well organized pocket	Chronic pyelonephritis. Hydronephrosis or nonfunctioning kidney

more extensive the removal of potential cancer-bearing tissue, the greater the likelihood of injury to normal organs in the operative area. The postsurgical complications other than those involving the urinary tract are similar to those in any major operation and are usually amenable to therapeutic measures without leading to permanent disabilities. Most of the urinary tract complications produce characteristic roentgen manifestations and can thus be recognized by a radiologist with a considerable degree of assurance.

The basis for our study was an analysis of follow-up roentgenograms in the postsurgical period in 25 cases of radical hysterectomy with pelvic lymphadenectomy. Two cases from other institutions are also used to illustrate particular roentgen manifestations. No attempt was made to evaluate the incidence rate of any particular complication, since that aspect of the problem is dealt with in several recent reports from various medical centers (9, 15, 24). The roentgen findings to be discussed, and their anatomical bases, are summarized in Table I.

The postsurgical urinary tract complications may be divided into two distinct groups: early and late.

(*a*) *Early or Immediate Complications:* To the early or immediate group belong generalized ectasia of the upper collecting system including the ureters, diminished

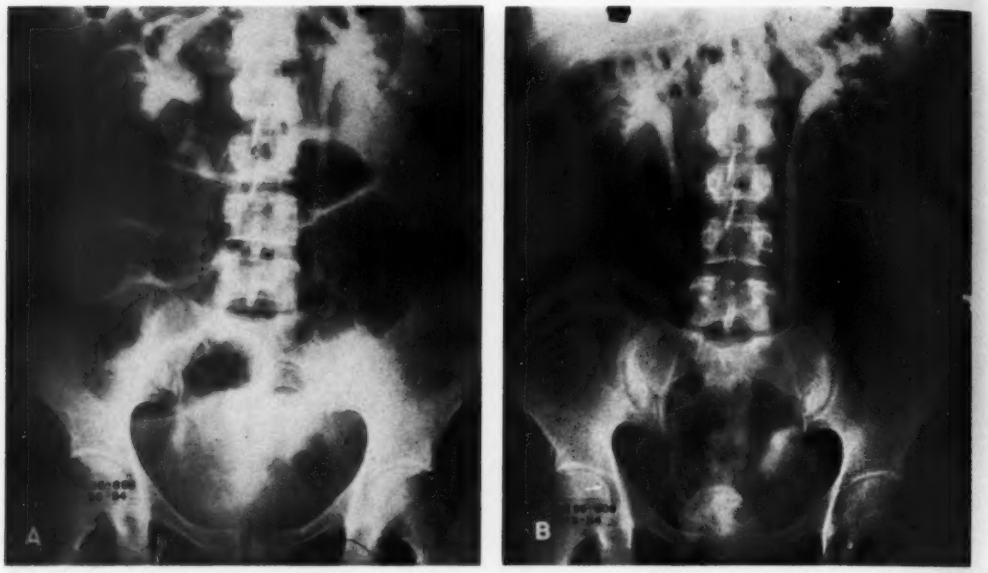

Fig. 2. Case VII. A. Intravenous pyelogram fifteen days postoperative, showing the atonic bladder with bilateral hydronephrosis. The distal right ureter shows edematous narrowing causing partial obstruction. On the left, partially obscured by contrast material in the bladder, is a vague area of increased density, indicating extravasation.

B. One week later an extravasation pocket is well formed on the left. The edema of the right ureter has diminished and the obstruction has receded.

excretory function of the kidneys, bladder atony, and urinary infection secondary to stasis. Most of the sequelae occur in varying degree in a majority of cases (Figs. 1, A; 2, A; 3, A). The surgical trauma, edema, and ischemia are primarily responsible for the early complications. The severance of the ureteral and pelvic visceral nerve supply is a contributing factor. Bladder atony, for instance, is present in practically every case but is usually transient. The roentgen features of these complications are shown in Table II.

Excretory urography is the most informative procedure. In the immediate postoperative period the films are not always of optimum diagnostic value because of gas in the intestinal tract due to mild ileus and also because the kidneys are not able to concentrate the contrast media as well as preoperatively. Ectasia of the pelvicalyceal system and the ureters, of varying degree, is a common finding (Fig. 2, A). The distal 4 or 5 cm. of the ureters may be of normal or diminished caliber, presumably due to edema of the mucosa and fluid accumulation in adjacent space (Fig. 2, A, Case VII). The ectasia of the collecting system regresses gradually as the ureteral edema disappears. Persistence of hydronephrosis beyond several weeks is strongly indicative of cicatricial obstruction of the ureter (Fig. 3).

The urinary bladder is most strikingly affected by surgical disruption of the pathways of the visceral nerves and vascular ischemia. An indwelling catheter should be used routinely for drainage, since these patients are unable to empty the bladder completely. The cystogram shows the bladder to be dilated, pyramid-shaped, or with tear-drop appearance. The contours may be grossly irregular, similar to the "Christmas tree" bladder (Fig. 1, A) commonly associated with severe pelvic trauma and vesical rupture. The postvoiding films will show large amounts of residual urine, usually in the neighborhood of 250 to 500 c.c. The atonicity of the bladder may persist for several weeks.

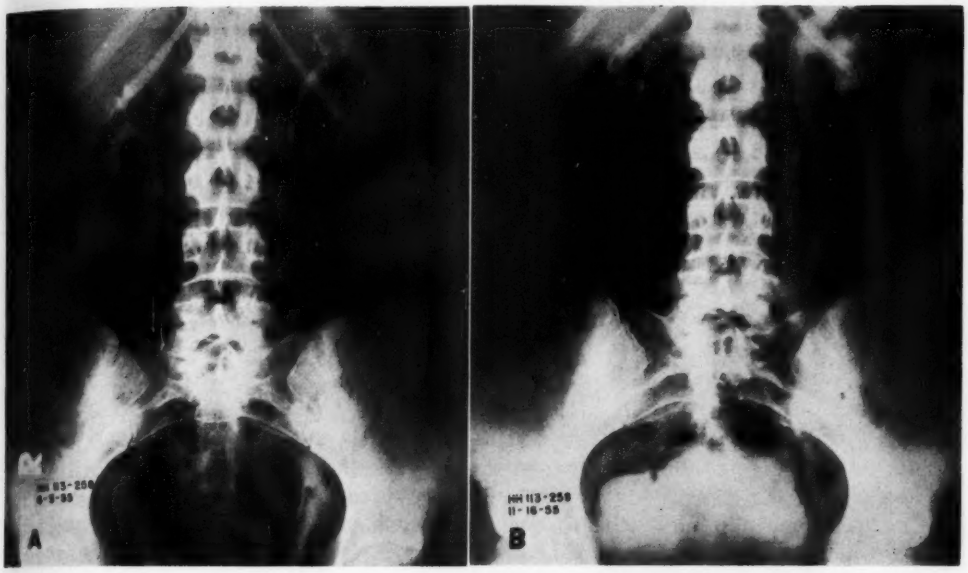

Fig. 3. Case VIII. A. Intravenous pyelogram twenty-three days after operation, showing contrast material from the left ureter dissecting between fascial planes.
B. Five months later the fistula has healed, but a left ureteral stricture has formed. Bladder atony persists.

In some instances re-establishment of normal control of the urinary bladder may fail to take place, thus resulting in a chronic urinary bladder dysfunction.

Urinary infection, a common immediate complication, is a contributing factor to pyelocaliectasis. The urographic changes in an *acute* infection *per se* are few. The diagnosis depends ultimately upon laboratory data.

(*b*) *Delayed Urinary Tract Complications:* Late complications include fistulas of all types, ureteral strictures, persistent dysfunction of the urinary bladder, and chronic infection of the urinary tract. The former two are of particular interest to the radiologist because their identification, evaluation of their course, and eventually the therapeutic approach depend ultimately upon the roentgen manifestations. In the latter two the radiological observations may be contributing factors in reaching a diagnosis.

Vesicovaginal and ureterovaginal fistulas are the greatest hazards. Their number is used as an index for the evaluation of postoperative urinary complications and to some extent the completeness of pelvic dissection. A recent report by Liu and Meigs (9), based on an analysis of 473 patients with radical hysterectomy and lymphadenectomy, records 45 fistulas of all types, *i.e.*, an incidence of 9 per cent. Others have reported a somewhat higher incidence (15, 24).

The ischemia resulting from the interruption of vascular supply to the terminal ureters and bladder is the main causative factor in the formation of fistulas. The collateral circulation fails to develop, the main vessel having been ligated, and avascular necrosis results at the site of the severest interference with the blood supply, which in the course of events leads to retroperitoneal extravasation of urine, superimposed infection, and fistula formation. Most reports are in agreement that the ureterovaginal fistulas are the most frequent, vesicovaginal being next. Combinations of the two or others are less frequent. Meigs (9) postulates that the overdistention of the urinary bladder in the immediate postsurgical period is an important contributing factor in the formation of the

TABLE III: TIME SEQUENCE OF FISTULA FORMATION IN TEN CASES

Case Number	Days from Operation to Symptoms Suggestive of Extravasation	Interval from Probable Extravasation to Passage of Urine from Vagina	Total Time from Operation to Actual Fistula Formation (days)	Type of Fistula
I	16	1	17	Ureterovaginal (bilateral)
II	10	24	34	Vesicovaginal
III	Unknown	..	16	Ureterovaginal
IV	13	10	22	Ureterovaginal
V	Unknown	..	20	Vesicovaginal and ureterovaginal
VI	7	4	11	Vesicovaginal and ureterovaginal
VII	8	5	13	Ureterovaginal
VIII	9	7	16	Ureterovaginal
IX	Unknown	..	Unknown	Ureterovaginal (bilateral)
X	Unknown	..	58	Vesicovaginal. Films failed to show lesion

fistula. According to him, the distended bladder lifts the ureter from its new bed and destroys the new and delicate blood vessels which are in the process of formation. Apparently in recent years he was able to reduce drastically the incidence of fistulas by proper bladder care.

Clinically, the actual perforation of the ureter may be associated with a sudden episode of pain in the adjacent regions or referred to the site of perforation, such as back pain with radiation to the inner thigh (Case I) or suprapubic pain (Case IV), or there may be a sudden rise in temperature as a manifestation of infection (Cases III and V). The perforation and leakage of urine from the vagina may also occur without dramatic clinical symptoms (Case VI). Unless the complication is due to an unrecognized surgical accident, the symptoms of urinary extravasation do not appear until one week to ten days after operation (Table III). On the average, another seven to fourteen days will elapse before communication with the vagina takes place. Apparently, in spite of a compromised blood supply, the ureter and bladder floor are capable of variable function for a considerable time while undergoing necrosis, before the occurrence of actual dissolution of the wall.

When the urine leak-through does occur in the initial phase, the excretory urogram will show extravasation of the contrast medium as an ill defined shadow at the level of the intrapelvic portion of the ureter, spreading within the retroperitoneal space between fascial planes (Fig. 3, B). This shadow may be very faint and readily overlooked (Fig. 2, A).

The subsequent course of events will show varying roentgen manifestations in follow-up studies. The leak-through may heal spontaneously, as seen in only 1 of our cases (Case I) but reported frequently in other series (9, 15). The extravasated urine spaces are fertile ground for secondary infection (Case IX). The urine-filled space and the fistula tract may organize. The roentgenogram will then show the fistula tract sharply outlined, suggesting an epithelialized pocket (Fig. 1, B, Case I). With a retrograde pyelogram, the exact site of the fistulous tract may be determined. Vesicovaginal fistulas have not been demonstrated by intravenous pyelography even in the presence of definite clinical manifestations such as a urine leak from the vagina, since the anatomical relationships of the upper vagina are overshadowed by the opacified bladder. Under those circumstances cystography with oblique views will be of great value.

A series of colored substances may be used during cystoscopy for obtaining a general idea of different pathways of communication with the exterior. If the urine is definitely draining per vagina, methylene blue is instilled into the bladder. If the bladder is intact, as indicated by the fail-

ure of the dye to appear in the vagina, one may assume that the leak is higher in the urinary tract. Proof of a ureterovaginal communication is obtained by instilling sterile milk within the bladder and injecting indigo carmine intravenously. If the indigo carmine appears in the vagina, unstained by milk, a ureterovaginal fistula exists. When both types of fistula are present, a combination of cystoscopy and dye studies and an intravenous pyelogram is essential for diagnosis.

Ureteral stricture is the second most serious delayed complication of radical hysterectomy. The terminal 4 to 5 cm. of the ureter is the usual site of postsurgical scarring in the periureteral sheath and wall of the ureter. During the first few weeks following operation, the excretory urogram may disclose a narrowing of the terminal segment of the ureter with hydronephrosis due to edema of the mucosa and wall. This may subside in about one month, with return of the ureter to normal (Fig. 3, B, Case VIII). If the damage to the ureteral wall is sufficient, fibrous tissue will replace the normal musculature in three to four months and a stricture will result. If the stricture is of high degree, a marked hydronephrosis with severe loss of kidney function and eventually a "silent" kidney will follow (Case V).

A method of repair by substituting an isolated loop of ileum with its intact blood supply has been devised by Mellinkoff and reported by several authors (14). The ureter is sutured into the wall proximally, and the distal segment of ileum is inserted into the fundus of the bladder. Pyelographic examination in these patients can be conducted by the usual intravenous technic if good renal function exists (Fig. 4). When only structural changes are to be investigated, the bladder, ileal loop, and upper collecting system, may be outlined by a delayed cystogram, obtained by instilling the medium into the bladder and having the patient hold her urine for ten to fifteen minutes. Opaque material will flow retrograde from bladder to ileal loop to ureter and pelvocalyceal system.

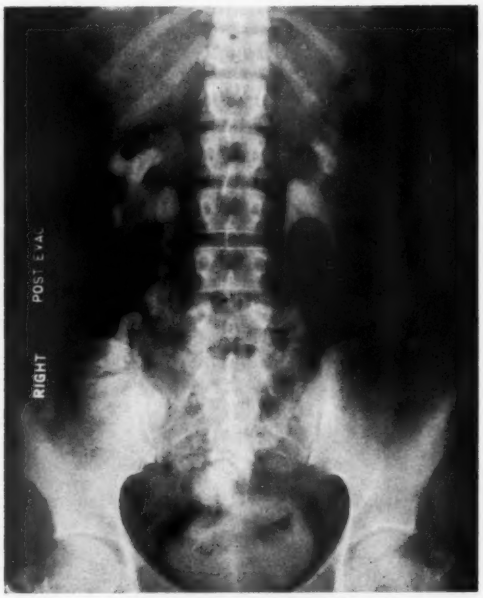

Fig. 4. Case IX. Delayed cystogram, two and a half years after Wertheim hysterectomy and two years following substitution of an ileal loop for the lower ureters. The bladder, isolated ileal loop, proximal ureters, and pelvocalyceal system are outlined by the contrast medium. Although hydronephrosis and bacilluria persist, the patient is asymptomatic.

SUMMARY

Urinary tract injuries following radical hysterectomy and pelvic lymphadenectomy are primarily related to interference with the blood and nerve supply to the distal ureter and bladder.

The lower urinary tract is initially atonic and edematous. If necrosis and infection occur, scarring and stricture formation develop.

The most serious complication is fistula formation, which can be demonstrated by intravenous pyelography if ureterovaginal or by a cystogram if vesicovaginal in location. Rectovaginal fistulas have not as yet been encountered.

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SUMMARIO IN INTERLINGUA

Diagnose Roentgenographic De Complicationes Urinari Post Hysterectomia Radical E Dissection De Nodo Lymphatic Del Pelve

Complicationes major que affice le vias urinari post hysterectomia radical e dissection de nodos lymphatic del pelve in casos de carcinoma del cervice resulta ab un deficiente provision de sanguine con le resultato de necrose de histos. Le majoritate de tal complicationes produce characteristic manifestationes roentgenologic e per consequente pote esser recognoscite per le radiologo. Super le base de un bon comprension del technicas chirurgic e del circumstantias anatomic il es possibile predicer le constatationes roentgenologic e le chronologia consecutive de lor occurrentia possibile.

Complicationes immediate consiste de ectasia generalisate del systema de collection superior, de function excretori reducite in le renes, de atonia del vesica, e de infection urinari secundari a stase. Complicationes tardive es fistulas (principalmente uretero- e vesico-vaginal), strictura ureteral, dysfunction persistente del vesica urinari, e infection chronic del vias urinari. In casos del ultime duo, le constatationes radiologic pote esser de adjuta in le diagnose. In casos del prime duo, le constatationes radiologic es de signification primari pro identificar le condition, evalutar su curso, e determinar le mesuras therapeutic.

Le plus grave complication es le formation de fistulas. Fistulas uretero-vaginal pote esser demonstrate per pyelographia intravenose; fistulas vesico-vaginal per cystographia.

Roentgen Diagnosis of Sex Based on Adult Skull Characteristics

Comparison Study of Cephalometry of Male and Female Skull Films (Frontal Projection)[1]

JORGE L. CEBALLOS, M.D.,[2] and E. H. RENTSCHLER, M.D.[3]

A SURVEY OF THE medical literature indicates that there has been no attempt to compare definitively skull radiographs of the male and female adult. Keen (1) has presented this problem from the standpoint of the anthropologist and it was felt that a comprehensive evaluation of the roentgenology would be of value and interest. It was also felt that such a study might be of some importance medico-legally. We have been encouraged by a personal communication (2) to develop this comparison.

METHODS

The basis for this paper was the evaluation of 100 normal adult male and 100 normal adult female skull films. The ages of the male patients ranged from twenty to seventy-two years and the females from twenty-two to eighty-six years. The films were compared with regard to the following characteristics noted on the frontal projection (postero-anterior):

(1) *Sagittal diameter:* Measurement of the distance from the top of the skull in the midline to the lower edge of the mandible in the same plane.

(2) *Mastoid length:* Measurement of the distance from the inferior tip of the mastoid process to the petrous ridge perpendicularly above the mastoid tip.

(3) *Mandible width:* Measurement of the distance from one lateral border of the mandible to the other similar border at the level of the mastoid tip.

(4) *Mandible angle width:* Measurement of the width of the mandible at the angle, this being the distance from the outer to the inner margins.

Figure 1 shows the points at which the measurements were obtained.

Only films made with the mouth closed were included. The distance from the tube to the film was 36 inches, and the central ray was either straight (perpendicular) or angulated 10° toward the feet.

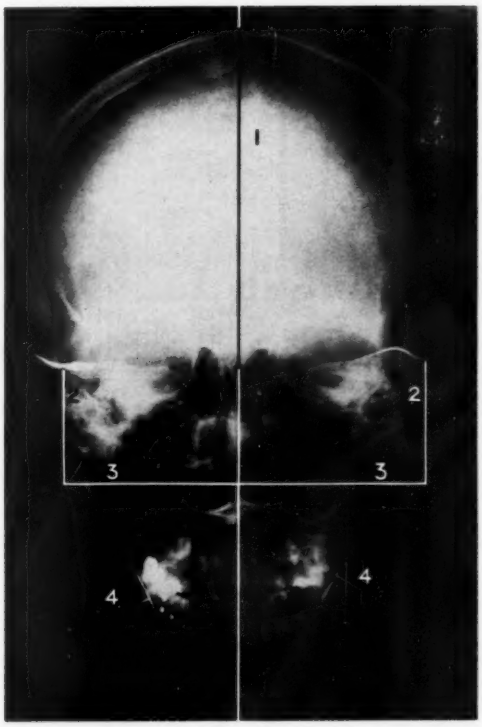

Figure 1.

In evaluating the results, an attempt has been made to predict the sex of the patient, thereby testing the validity of identification of male and female skulls by the measurements used.

RESULTS

The results of the measurements of the diameters listed above are portrayed graphically in Tables I–IV. The ordinate line represents the number of cases and the abscissa line the measurement in

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TABLE I

SKULL (FRONTAL VIEW): SAGITTAL DIAMETER
TOTAL NO. OF CASES: 100 FEMALES 100 MALES

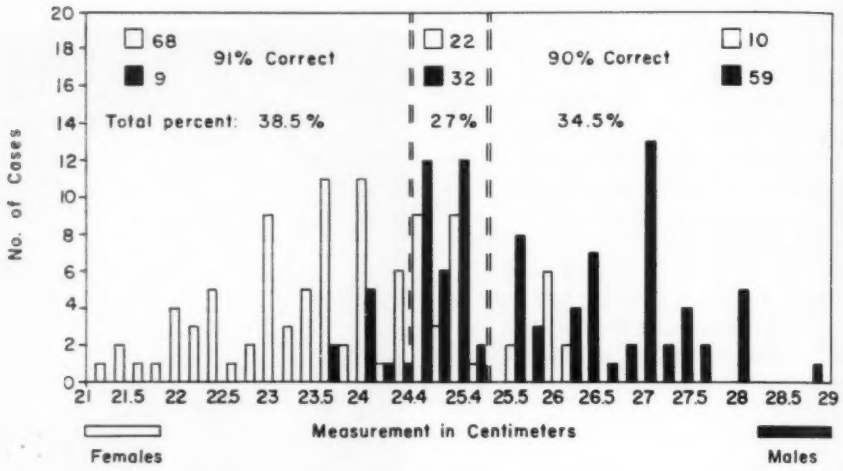
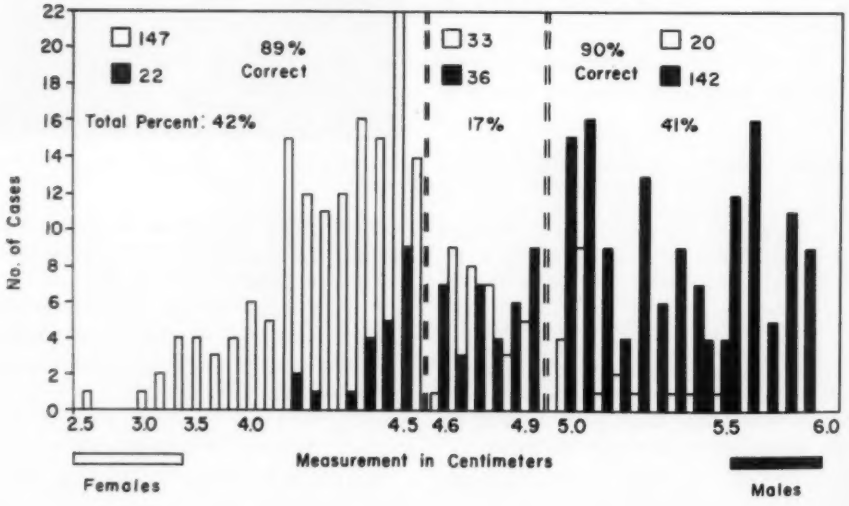


TABLE II

MASTOID LENGTH: FROM PETROUS LINE TO MASTOID TIP
TOTAL NO. OF CASES: 100 FEMALES (Right side) 100 (Left side)
100 MALES (Right side) 100 (Left side)



centimeters in all cases. The left side of each table includes the female cases and the right side represents the males. In the center of each table there is an area which includes those cases in which the measurements are similar for the sexes. We have termed this area of overlapping the "neutral zone."

Table I presents the data comparing the sagittal diameters. If we accept the limits of the diameter from 21.0 to 24.4 cm., the diagnosis of female by this

measurement is 91 per cent accurate. The "neutral zone," where the upper diameters of the female skull and the lower diameters of the male skull overlap, is from 24.5 to 25.4 cm. From 25.5 cm. upward the prediction of male by this measurement is 90 per cent accurate.

Table II is a comparison of the mastoid length. The measurements from 2.5 to 4.5 cm. will include 89 per cent of the female cases. The "neutral zone" is from 4.6 to 4.9 cm. Of the male cases, 90 per cent measure 5.0 cm. and above.

Table III compares mandibular width. 97 per cent of the female cases are included between the measurements of 10.0 and 11.5 cm. The "neutral zone" is from 11.6 to 12.0 cm. A measurement of 12.0 cm.

TABLE III

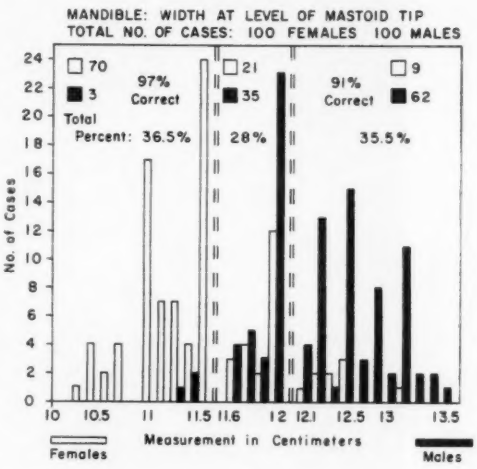
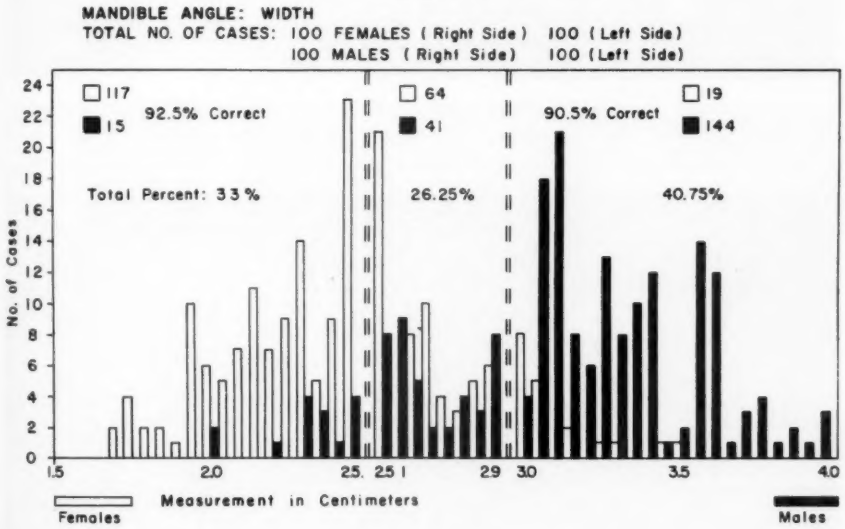


TABLE IV



or greater will predict a male skull by mandibular width in 91 per cent of the cases.

Table IV shows the comparison of the measurements at the mandibular angle. The measurements of 1.5 to 2.5 cm. include 92.5 per cent of the female cases. The "neutral zone" is from 2.6 to 2.9 cm. Measurements of 3.0 cm. or above will indicate a male skull in 90.5 per cent of the cases.

Figure 2 shows sample measurements for male and female which would select 100 per cent of the female skulls (left) and 100 per cent of the male skulls (right). Figure 3 shows examples of "failures." On the left the female skull has a "neutral" sagittal diameter, mandibular width, and mandibular angle measurement. The mastoid length, however, is definitely in the male range. On the right the male "failure" has a "neutral" mastoid length but the

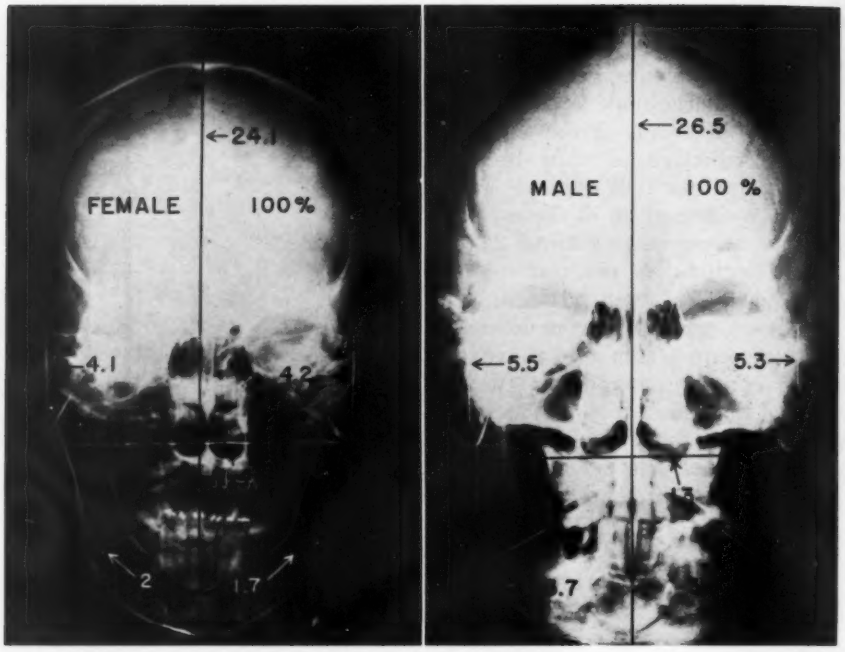


Figure 2.

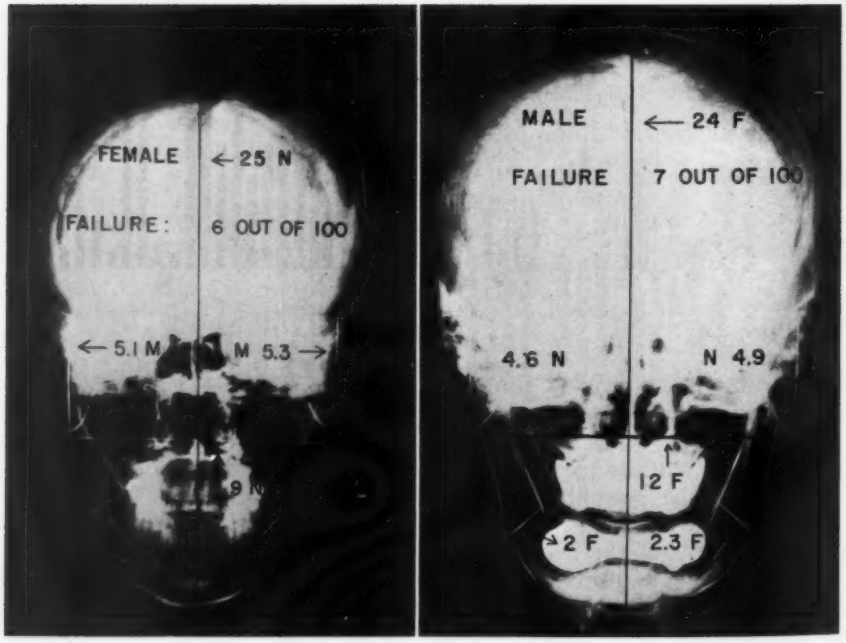


Figure 3.

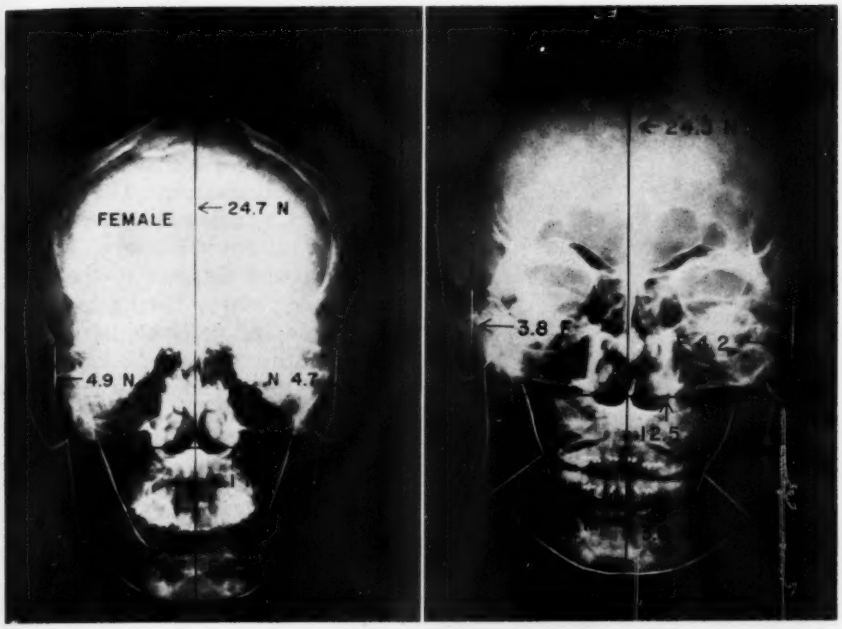


Figure 4.

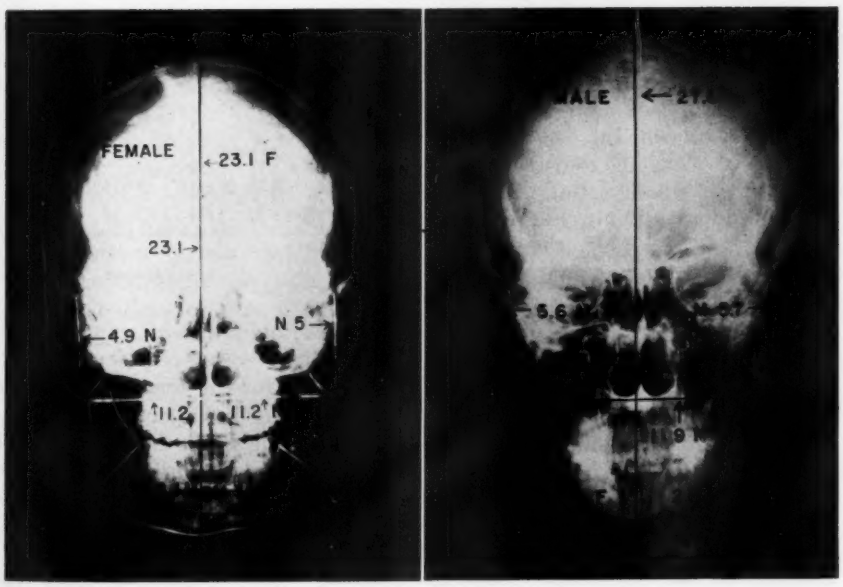


Figure 5.

remaining 3 measurements correspond to those of the female.

Figure 4 shows a "neutral" skull on the left with a "neutral" sagittal diameter, mastoid length, and mandibular width. The mandibular angle measurement is definitely in the female range and would be diagnosed correctly with this as the cue.

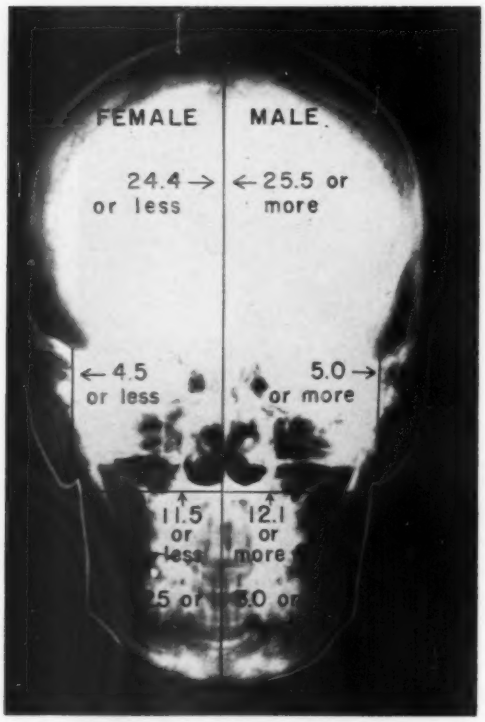


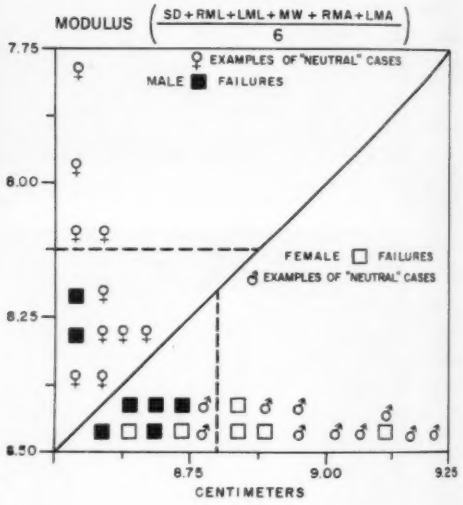
Figure 6.

The "neutral" case on the right has a sagittal diameter which is "neutral," the mastoid length is "female," but the mandibular width and mandibular angle measurements are "male." This, then, could be predicted correctly to be a male skull.

Figure 5 includes 2 more of the "neutrals." On the left the sagittal diameter and mandibular width are "female," the mandibular angle measurement is "male," and the mastoid height is "neutral." This, then, could be selected as a female skull. The skull on the right has a "neutral" mandibular width and the mandibular angle width is "female" on one side and "neutral" on the other side. The mastoid length and the sagittal diameter are "male," thus suggesting that this is a male skull.

Table V deals with those cases in the "neutral zone" and with the "failures." The modulus on this graph is obtained by addition of the sagittal diameter (SD), right mastoid length (RML), left mastoid length (LML), mandible width (MW), right mandible angle width (RMA), and left mandible angle width (LMA), and dividing this total by 6. Those cases on the abscissa line include "neutral" cases with male tendency. The modulus increases in the male cases. On the ordinate we have "neutral" cases with female tendency, with decrease of the modulus in the female cases. Also included here are the 7 male and 6 female "failures" found in the entire series. Utilization of this modulus thus extends the number of

TABLE NO. V



accurate predictions of sex by skull examination to 98 per cent for the males and 94 per cent for the females. However, we have arbitrarily selected 8.125 as the upper limiting figure for female skulls and 8.8 as the lower limiting figure for male skulls, as shown by the dotted lines on the modulus. This then excludes six more female "neutral" cases and two more "neutral" male cases, changing the level of accuracy to 88 per cent for the females and 91 per cent for the males.

Figure 6 portrays the range of measurements to be used to diagnose the male and female skulls. On the left it is seen that any sagittal diameter 24.4 cm. or less is

characteristic of the female skull. The remaining dimensions of the female skull are 4.5 cm. or less for the mastoid length, 11.5 cm. or less for the mandibular width, and 2.5 cm. or less for the mandibular angle width. Measurements in these ranges will select the female cases. On the right the measurements predicting the male skulls are shown: sagittal diameter 25.5 cm. or above, mastoid length 5.0 cm. or more, mandibular width 12.1 cm. or greater, and mandibular angle width 3.0 cm. or more.

SUMMARY

Comparison of 100 normal adult male and 100 normal adult female skulls has been made from a roentgenologic standpoint. They have been compared as to sagittal diameter, mastoid length, mandibular width at the level of the mastoid tips, and mandibular angle width.

The comparison of the findings in these two groups shows that there are characteristic dimensions for the male and female and that sex can be predicted in 88 per cent of the cases by utilization of these dimensions.

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SUMMARIO IN INTERLINGUA

Diagnose Roentgenologic Del Sexo Super Le Base De Characteristicas Adulte. Studio Comparative De Cephalometria Con Projectiones Frontal De Cranios Mascule E Feminin

Es executate un comparation, ab le puncto de vista roentgenologic, de 100 normal adulte cranios mascule con 100 normal adulte cranios feminin. Le cranios esseva comparate con respecto a diametro sagittal, longor mastoide, largor mandibular al nivello del extremitates mastoide, e largor del angulo mandibular. Le expositiones esseva facite con le bucca claudite.

Un comparation del constatationes in le duo gruppos demonstra que il existe dimensiones characteristic de cranios mascule e de cranios feminin e que le utilisation del mesurationes permitte le identification del sexo in 88 pro cento del casos. Le valores es le sequente: Pro femininas—diametro sagittal, 24,4 cm e minus; longor mastoide, 4,5 cm e minus; largor mandibular, 11,5 cm e minus; e largor del angulo mandibular, 2,5 cm e minus. Pro masculos—diametro sagittal, 25,5 cm o plus; longor mastoide, 5,0 cm o plus; largor mandibular, 12,1 cm o plus; e largor del angulo mandibular, 3,0 cm o plus.

Neurofibromatosis and Intrathoracic Meningocele[1]

CARROLL J. LaVIELLE, M.D., and DARRELL A. CAMPBELL, M.D.

IN 1933 POHL (1) reported the first case of intrathoracic meningocele which was associated, incidentally, with cutaneous neurofibromatosis. Since that time there have been described 19 similar cases and 10 of meningocele without neurofibromatosis. Of 3 bilateral cases, 2 were associated with neurofibromatosis.

The pathologic changes which permit the formation of a meningocele have been the subject of much discussion, and several theories have been advanced. We are presenting in this article an additional case of bilateral intrathoracic meningocele associated with neurofibromatosis, with a seven-year follow-up. We are also proposing a theory of genesis.

A 36-year-old Caucasian female was admitted to the hospital in 1949 for investigation of a mass in her right chest. Recurrent episodes of low thoracic pain had occurred over the past ten years. Slight tenderness was present over the lower thoracic vertebrae but no bone abnormalities could be palpated. Numerous soft skin papules and brownish pigmentations typical of von Recklinghausen's neurofibromatosis were found. No neurologic deficit was noted.

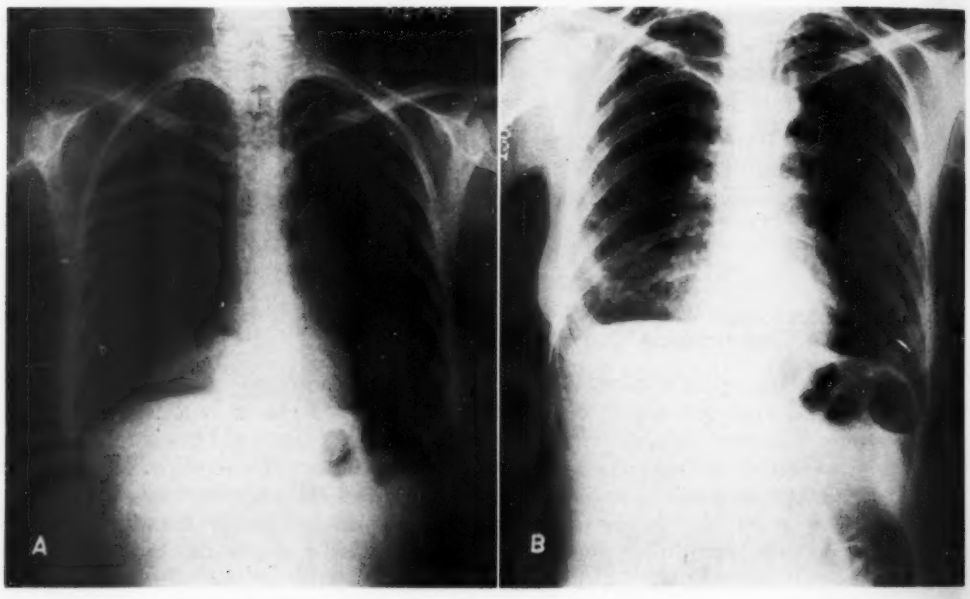

Fig. 1. A. Preoperative film showing meningocele in lower right chest, and lower margin of left meningocele through gas bubbles in the intestinal tract.
B. Postoperative chest roentgenogram showing pleural thickening on right and better visualization of left retrocardiac meningocele.
Courtesy of Departments of Radiology and Pathology, Wayne County General Hospital, Eloise, Mich.

Roentgenograms (Fig. 1) revealed a rounded mass in the posterior right chest as well as scalloped defects of the posterior margins of the lower thoracic vertebrae and dislocation of the right eleventh rib (Fig. 2). A preoperative diagnosis of intrathoracic neurofibroma and cutaneous neurofibromatosis was made.

Thoracotomy showed the mass to be a large meningocele communicating with the spinal canal through defects in the pedicles of the tenth and

[1] From the Departments of Radiology and Surgery, St. Joseph Mercy Hospital, Ann Arbor, Mich. Accepted for publication in July 1957.

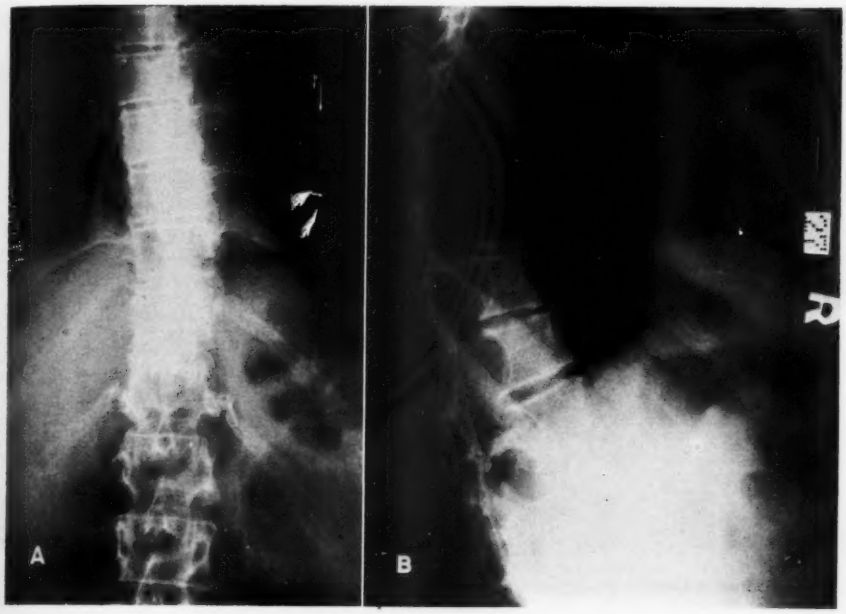

Fig. 2. A. Anteroposterior projection showing dislocation of right eleventh rib.
B. Lateral view showing scalloped margins of vertebrae and pedicle defects.
Courtesy of Departments of Radiology and Pathology, Wayne County General Hospital, Eloise, Mich.

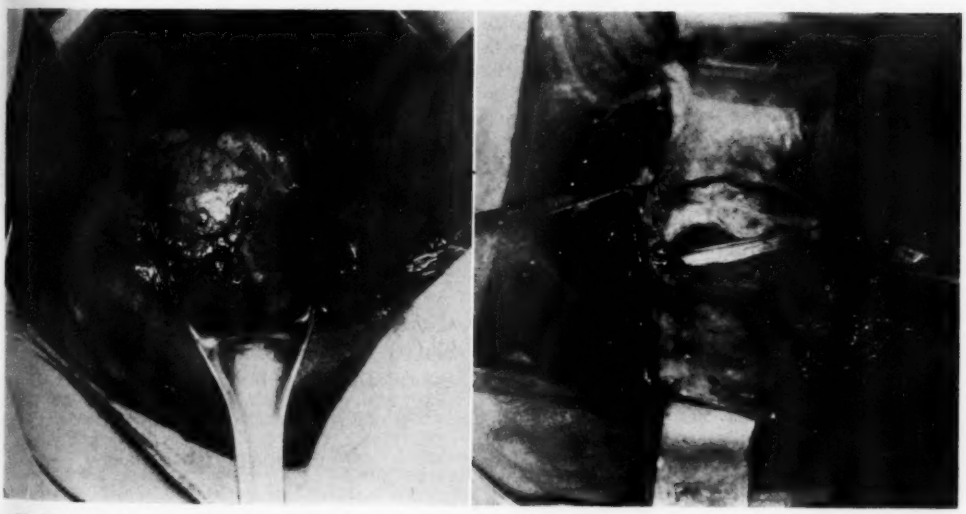

Fig. 3. Right intrathoracic meningocele as seen at surgery. The right-hand view is of the opened meningocele, showing the spinal cord at the base of the tumor and the pedicle defects of vertebrae.
Courtesy of Departments of Radiology and Pathology, Wayne County General Hospital, Eloise, Mich.

eleventh thoracic vertebrae (Fig. 3). The sac was aspirated and excised, and the dura was imbricated over the defect. The postoperative course was uneventful. An overexposed chest film following operation revealed a hitherto unsuspected mass in the left retrocardiac area, but no further treatment was instituted.

In the ensuing years the patient was well except

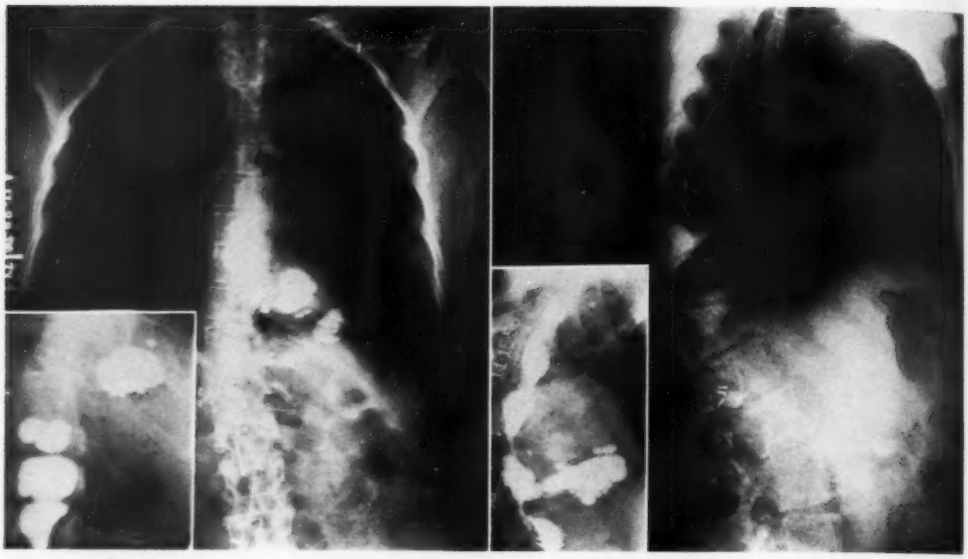

Fig. 4. Myelograms at time of second hospitalization, showing communication of left meningocele with spinal canal.

for a mild backache. In 1956 this became severe enough to warrant further treatment. Spine films again showed defects in the lower thoracic vertebrae, and myelography revealed a communication between the spinal cord and the left retrocardiac mass (Fig. 4), thus establishing its identity as a meningocele. This mass had not enlarged in the intervening years and no recurrence was noted on the right. Fusion of the involved vertebral segments was performed and the meningocele was left undisturbed.

A review of the 20 published cases of intrathoracic meningocele associated with cutaneous neurofibromatosis revealed vertebral deformities but no other bone involvement. Pohl believed that the changes were caused by periosteal neurofibromas, but Gould (2), reporting on microscopic sections of vertebrae of patients with neurofibromatosis, stated that the only abnormal finding was a very marked excess of osteoid tissue, with relatively little normal bone. Moore (3) attributed the abnormal bone to a lack of control of ordinary growth processes. He found endarteritis associated with the deformities and suggested that the autonomic nerves controlling the vascular supply to these bones might be at fault. Aegerter (4) believed that in neurofibromatosis there exist both true neoplasms and hamartomatous proliferations of fibrous tissue that may undergo metaplasia to poor and disorganized bone. Hackensellner (5) stated that bony dystrophy, dural weakness, and differential spinal fluid pressures are involved. Cross (6), Cymral (7) and Ciaglia (8) all incriminated dural defects as important etiologic factors, while Miller (9) and Moyer (10) proposed that the bone lesions are part of multiple congenital mesodermal anomalies.

Of the 10 published cases of meningocele without neurofibromatosis, 6 showed associated vertebral defects and 1 Paget's disease. In 3 no bone changes were mentioned.

CONCLUSIONS

We believe that intrathoracic meningocele, a relatively uncommon entity, can occur only in conjunction with other abnormalities. More than two-thirds of all reported cases have been associated with cutaneous neurofibromatosis. We propose that congenital mesodermal anomalies are the basic cause of these meningoceles.

The anomaly may be a weakness of the dura, a softened bone, easily eroded or distorted, as in neurofibromatosis, or an actual structural abnormality such as hemivertebrae or pedicle defects. A combination of dural and bone abnormality is probably necessary, since bone defects may occur without associated meningoceles, and in our case no recurrence was noted seven years after surgery, even though the bone defects were still present.

Variations in spinal fluid and intrathoracic pressures may aid and abet the herniation. Note should be made that neurofibromatosis itself is not a tumor of the nerves but rather a tumor of the neural sheaths which, like the dura, may be mesodermal in origin.

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SUMMARIO IN INTERLINGUA

Neurofibromatosis E Meningocele Intrathoracic

Es presentate un caso de bilateral meningocele intrathoracic, associate con neurofibromatosis cutanee, defectos edentate del margines posterior del inferior vertebras thoracic, e dislocation del deceprime costa al latere dextere. Le caso

esseva sequite durante un periodo de septe annos.

Super le base del presente caso e de 29 altere casos de meningocele previemente reportate in le litteratura, le autores conclude que meningocele intrathoracic pote occurrer solmente in conjunction con altere anormalitates. Plus que duo tertios de omne le casos reportate esseva associate con neurofibromatosis cutanee. Es formulate le these que congenite anomalias mesodermic es le causa fundamental de meningoceles. Le anomalia pote esser un debilitate del dura, un osso mollificate que es facilemente erodite o distorquite como per exemplo in neurofibromatosis, o un ver deviation structural como per exemplo hemivertebras o defectos pedicular. Un combination de anormalitate de dura e de osso es probabilemente necessari.

Buckling of the Aortic Arch (Pseudocoarctation, Kinking): A Roentgenographic Entity[1]

G. MELVIN STEVENS, M.D.

SINCE THE first report of buckling of the aortic arch by Souders *et al.* in 1951 (12), occasional reports have appeared in the literature substantiating their observations and more firmly establishing this anomaly as a distinct anatomic and roentgenographic entity (2, 4, 5, 7, 9, 11–14). Because most such reports have appeared in the nonradiologic literature and the recognition and understanding of the roentgenographic appearance is not generally appreciated, it seems warranted to report 4 such cases seen by the author. In all, perhaps fewer than 35 cases have been referred to in the English literature.

In essence we are speaking here of an anomalous buckling or kinking in the contour of the aortic arch, located at the usual site of insertion of the ligamentum arteriosum. The abnormal aortic contour thereby produced may simulate aortic coarctation, aneurysm, or mediastinal tumor and result in unnecessary surgery, radiation therapy, or angiocardiography. Each of these errors of diagnosis has been described. Through these misinterpretations, we have gained valuable surgical descriptions (12) and angiographic illustrations (4, 5, 11–13) of the anomaly, thereby permitting simple radiographic confirmation of the diagnosis in most cases.

The buckling or kinking in all reported cases has occurred at the aortic isthmus in the region of insertion of the ligamentum arteriosum. Where accurate observations have been made, the ligamentum is reported to be unusually short. Due to, or coupled with, the short ligamentum is a posteriorly directed double convexity of the aortic arch and upper descending aorta centered about the point of fixation of the aorta. The portion of the arch above the kink generally extends higher into the superior mediastinum than usual, then descends to the point of the kink, deviates abruptly posteriorly and to the left, then descends to the right. There is no regularity, however, of the exact aortic course in the reported cases. It should be stressed that the buckling described produces no significant reduction in the aortic lumen.

ROENTGENOGRAPHIC FEATURES

The postero-anterior view nearly always provides the initial clue to aortic buckling. In this projection one sees, in the shadow of the descending arch, an indentation produced by the profile of the anomaly. In some instances the appearance is only that of a generous-sized aortic "knob," with an abrupt indentation at its inferior pole and a second convexity in the descending arch below this point. Others present a double convex contour of the "knob," with the superior of the two convexities less dense than the inferior. The upper density is produced by the portion of the arch proximal to the kink, while the lower represents the devious aortic course just distal to the anomaly. At times the upper arch is largely obscured by the thoracic vertebrae and the lower convexity simulates an inferiorly displaced knob. It is the portion of the arch distal to the kink which produces an indentation on the barium-filled esophagus in such cases. While it is the postero-anterior view which suggests the diagnosis, it is the lateral or left anterior oblique view which generally confirms the suspicion. In the latter projections one can identify the abrupt indentation on the posterior and left lateral surface of the aorta at the expected level of ligamentum arteriosum insertion. If any significant difference exists in the aortic diameter proximal and distal to the anom-

[1] From the Department of Radiology, Palo Alto Clinic, Palo Alto, Calif. Accepted for publication in July 1957.

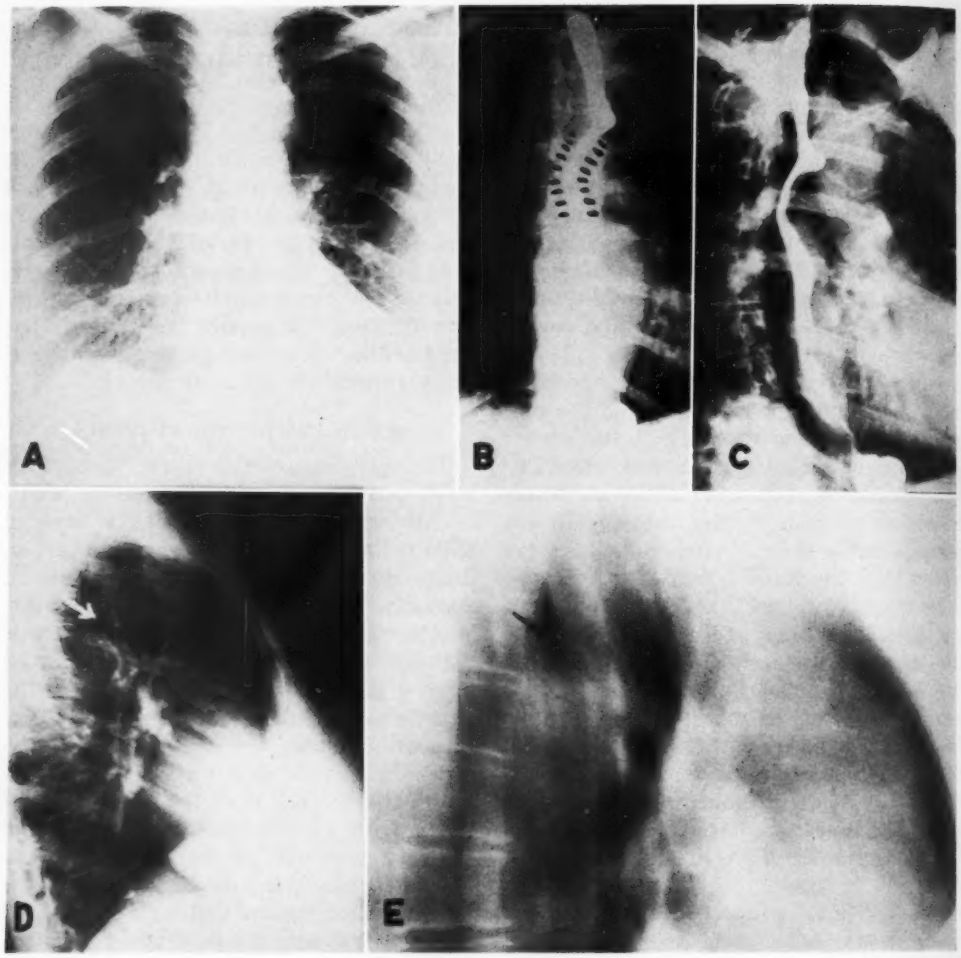

Fig. 1. Case I. Buckling of the aorta

A. Double convex density of the aortic arch.
B. Typically the lower of the two convexities produces the usual impression on the barium-filled esophagus.
C. Right anterior oblique view.
D. The arrow is directed toward the area of buckling. The arch passes higher into the superior mediastinum than usual.
E. Lateral planigram of anomaly. The descending aorta is slightly dilated.

aly, it is the distal portion which may be slightly dilated. This is probably to be explained by the increased hemodynamic turbulence produced by the kink. In most cases, for greater clarity of detail, it is advisable to carry out lateral or left anterior oblique body-section roentgenography. If doubt still exists as to the nature of the anomaly, angiocardiography should be done. In the 4 cases to be presented here, lateral planigrams and standard roentgenograms provided conclusive information.

CLINICAL FEATURES

There are no significant clinical findings associated with this anomaly except for a variously described transmitted precordial systolic murmur, probably produced, as Bruwer and Burchell (2) suggest, by increased turbulence. Not all patients, however, have such a murmur. The blood pressure and pulse are customarily normal

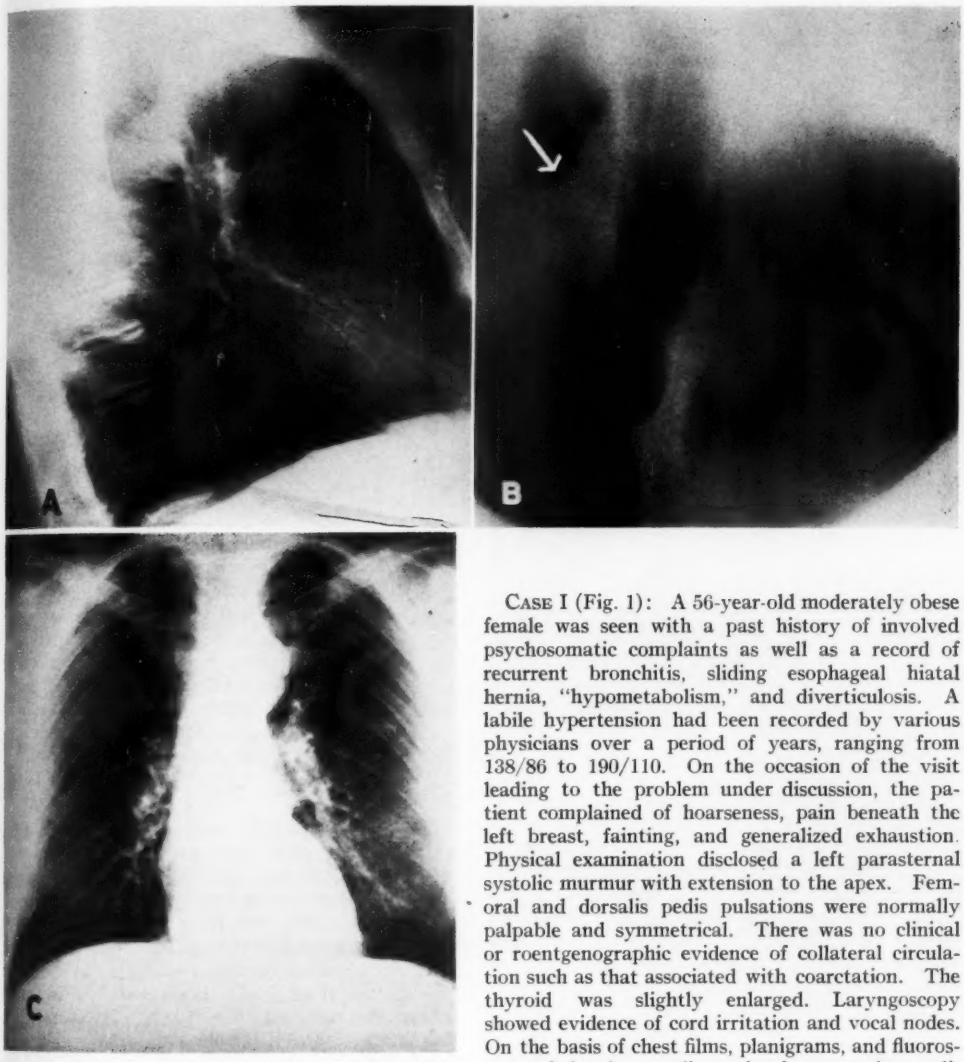

Fig. 2. Case II. Buckling of the aortic arch.
A. Lateral view depicting abnormal course and contour of aortic arch.
B. Lateral planigram. Buckling at expected level of ligamentum arteriosum insertion clearly seen. Upper arch and anomaly not in focus, due to difference in plane.
C. Note indentation in course of descending aorta, such as is seen in some coarctations.

in all extremities. An exception to this are the three cases of aortic buckling reported by Grishman *et al.* (7), which were associated with partial or nearly complete obliteration of the left subclavian artery, producing pulse asymmetry.

CASE I (Fig. 1): A 56-year-old moderately obese female was seen with a past history of involved psychosomatic complaints as well as a record of recurrent bronchitis, sliding esophageal hiatal hernia, "hypometabolism," and diverticulosis. A labile hypertension had been recorded by various physicians over a period of years, ranging from 138/86 to 190/110. On the occasion of the visit leading to the problem under discussion, the patient complained of hoarseness, pain beneath the left breast, fainting, and generalized exhaustion. Physical examination disclosed a left parasternal systolic murmur with extension to the apex. Femoral and dorsalis pedis pulsations were normally palpable and symmetrical. There was no clinical or roentgenographic evidence of collateral circulation such as that associated with coarctation. The thyroid was slightly enlarged. Laryngoscopy showed evidence of cord irritation and vocal nodes. On the basis of chest films, planigrams, and fluoroscopy of the chest, a diagnosis of an anterior mediastinal mass was made. Substernal thyroid seemed the most likely explanation. On that assumption, a thyroidectomy type incision was made and the anterior mediastinum was explored to a point at least 3 inches below the sternal notch, as well as laterally about the arch of the aorta, but no tumor was found. The buckled segment was not actually exposed. Comparison of the chest films taken prior to surgery and two years thereafter showed no change in the appearance of the chest or contour of the aortic arch. An effort has recently been made to record the blood pressure in the lower extremities but, because of the marked obesity of the thighs, this proved to be impossible. What was misinterpreted on the earlier chest films as tumor can now

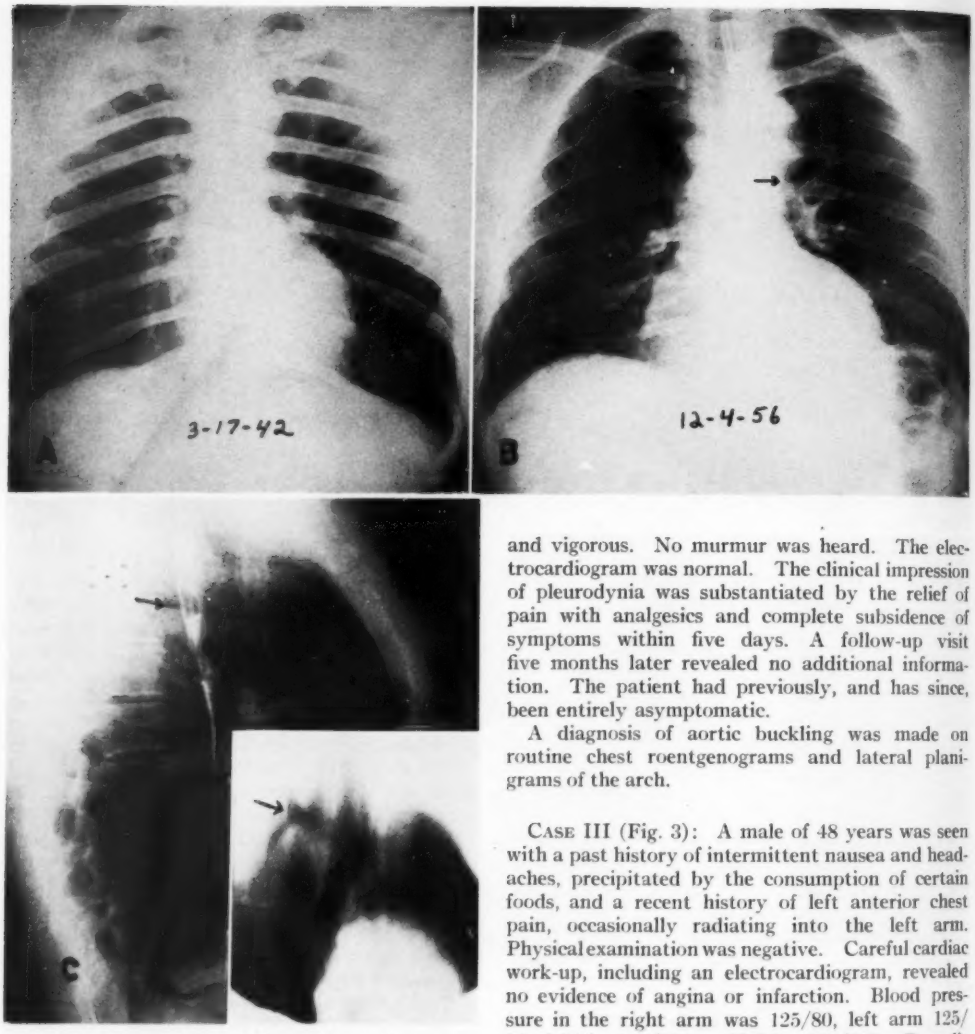

Fig. 3. Case III. Buckling of the aortic arch.
A and B. Alteration in the appearance of arch in fourteen-year period from near normal to obvious abnormality, produced by early degenerative changes of dilatation and elongation. Note the indentation in descending aorta (arrow).
C. Routine lateral view, with lateral planigram insert. Arrow points toward buckling anomaly.

be clearly seen in lateral planigrams to be buckling of the aortic arch.

CASE II (Fig. 2): A 51-year-old male was admitted with a twenty-four-hour history of pain of intermittent pleuritic type in the left anterolateral thorax. Physical examination was entirely negative. Blood pressure in the right arm was recorded as 130/86, left arm 132/86, right leg 160/130, left leg 158/126. All pulses were palpable, symmetrical, and vigorous. No murmur was heard. The electrocardiogram was normal. The clinical impression of pleurodynia was substantiated by the relief of pain with analgesics and complete subsidence of symptoms within five days. A follow-up visit five months later revealed no additional information. The patient had previously, and has since, been entirely asymptomatic.

A diagnosis of aortic buckling was made on routine chest roentgenograms and lateral planigrams of the arch.

CASE III (Fig. 3): A male of 48 years was seen with a past history of intermittent nausea and headaches, precipitated by the consumption of certain foods, and a recent history of left anterior chest pain, occasionally radiating into the left arm. Physical examination was negative. Careful cardiac work-up, including an electrocardiogram, revealed no evidence of angina or infarction. Blood pressure in the right arm was 125/80, left arm 125/86, right leg 142/114, and left leg 140/110. Dorsalis pedis pulses were normal and symmetrical. No murmur was audible.

A diagnosis of buckling of the aortic arch was made from the routine films and the planigrams.

CASE IV (Fig. 4): A 71-year-old male without any referable symptoms was seen at Stanford University Hospitals. A previous diagnosis of aortic aneurysm had been made. Routine chest films showed a buckling deformity. Fluoroscopy demonstrated an impression in the barium-filled esophagus by the lower of the two convexities. Clinical examination revealed a normal blood pressure and normal pulses in both upper and lower extremities. A systolic murmur had been present in the aortic area for many years.

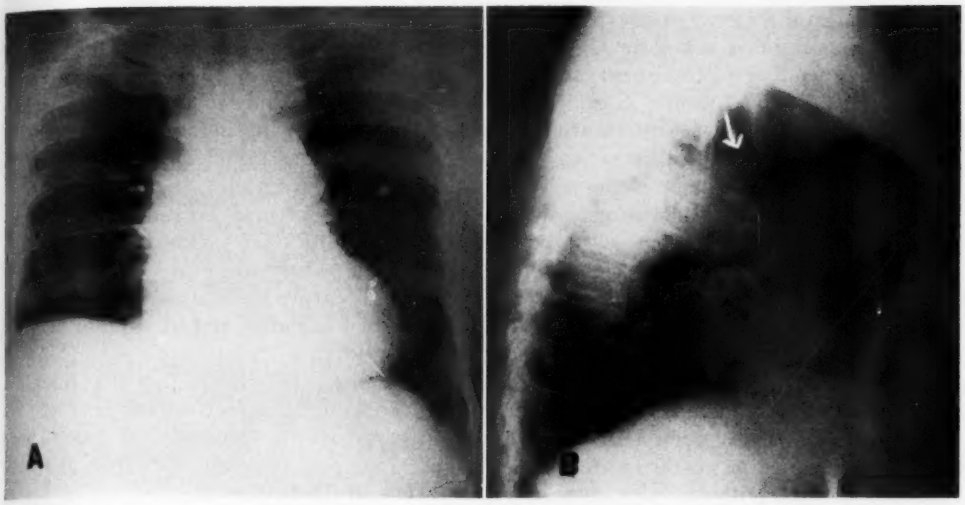

Fig. 4. Typical double convex descending aorta profile of aortic buckling (A), confirmed in lateral view (B)

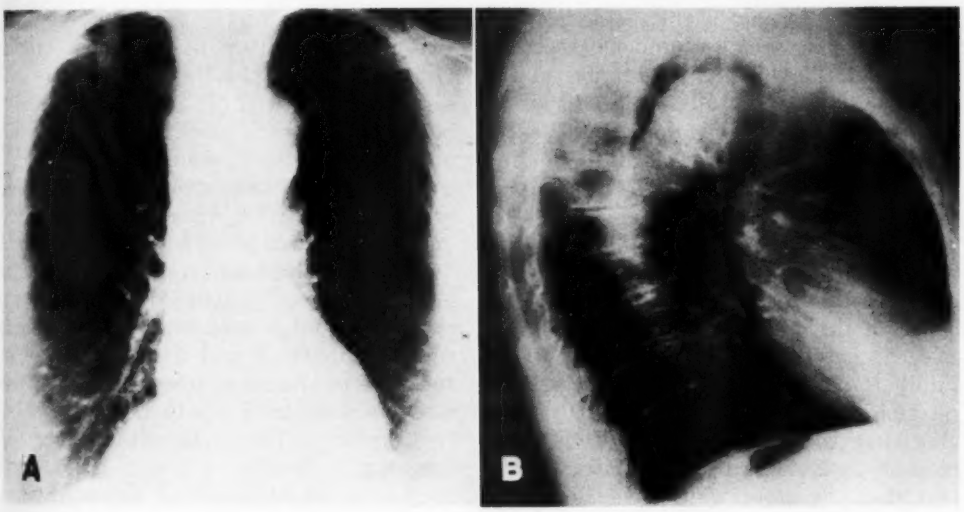

Fig. 5. Aneurysm of the aortic arch.
A. Double convex aortic arch shadow simulating buckling.
B. Lateral view clearly illustrates aneurysm of arch. Films two years earlier showed perfectly normal aortic arch. Right cardiophrenic angle shadow unchanged for years.

DIFFERENTIAL DIAGNOSIS

The radiographic features of aortic buckling could be most completely duplicated by coarctation (3), in reality making the differentiation a clinical one. Even with the use of angiocardiography the distinction may not always be clear (9), since the degree of obstruction in true coarctation may vary considerably and the rapidity of arterial return *via* the collaterals may be marked. In the great majority of coarctation cases, however, the correlation of roentgenographic features and physical findings provides a pathognomonic picture.

An aneurysm of the aortic arch may produce a picture suggestive of kinking in the

postero-anterior view, but the lateral view and planigrams will show the disparity of aortic caliber at the aneurysmal site (Fig. 5, A and B). Opacification of the aorta would serve as a definitive procedure if doubt existed. The differentiation of aortic aneurysm and a mass in the region of the arch could and should be made by the latter procedure.

The lateral and left anterior oblique views will exclude the confusing elongated arteriosclerotic aorta from consideration, since no sign of buckling is seen in the usual case.

In patent ductus arteriosus without peripheral evidence of recirculation or cardiac enlargement, the postero-anterior view may be confused with the picture of aortic buckling when there is dilatation of the infundibulum of the ductus. The latter produces a convexity in the region between the descending arch and upper descending aorta and thereby an indentation in the vascular profile (6). Again, lateral views, planigrams, or opacification of the aorta would resolve the problem if the distinction was not clear clinically.

DISCUSSION

Since this anomaly has been called pseudocoarctation by some, it is important that a line of distinction be clearly drawn between coarctation and buckling. Certainly the two anomalies are not related physiologically or clinically, and it is probable that they are not related developmentally. Evidence for the latter is the fact that the association of a short ligamentum has not been a common feature of coarctation. No stenotic segment or medial hypertrophy, such as is seen in coarctation, compromises the lumen in aortic buckling and there is, therefore, no upper extremity hypertension or collateral circulation. Finally, cases of buckling are divided approximately equally between males and females, whereas coarctation is seen from two to five times more commonly in males (9).

For many years it has been known that there is anatomical narrowing of the aortic lumen in the region of the isthmus (the segment between the subclavian artery and ductus arteriosus) in the fetal and newborn aorta (5). In some instances this circumferential narrowing persists into adult life. Abrams (1) has confirmed these observations by retrograde angiocardiography. While this fact may be related to the development of coarctation, it is probably unrelated to buckling, for in the latter the essential feature is an abnormal course and contour of the arch, not an area of luminal obstruction.

Evidence points to the fact that buckling is a congenital defect which may be accentuated by the processes of growth and aortic degenerative changes such as tortuosity and dilatation (Fig. 3). The age of the patients in the reported cases, including one male of twelve years and several under thirty, supports the idea that the deformity is of congenital origin. Other evidence of this theory is Souders' observation that, after division of a minimally patent ductus, the buckling anomaly did not change contour, either immediately or as observed on three-month postoperative follow-up films. A variety of associated anomalies have been reported including "relative infundibular stenosis," ventricular septal defect, patent ductus arteriosus, partial or complete obstruction of the left subclavian artery and aortic sinus aneurysm. The relative frequency of these associated anomalies is further corroborative evidence of the congenital etiology of buckling. Several authors have commented on slight aortic dilatation distal to the site of kinking. This appears to be of rather diffuse nature, not aneurysmal or localized as one would expect with the usual poststenotic dilatation.

When the defect is clearly apparent on the lateral or left anterior oblique standard films or on planigrams, there is no reason for further study. The patient can be reassured after what has probably been a tense period of iatrogenic anxiety. Lateral planigrams provided a clear-cut diagnosis in 3 of the cases described, while the routine films were diagnostic in Case IV.

CONCLUSIONS

(1) Aortic buckling is a rare congenital anomaly of the course and contour of the aortic arch occurring at the level of insertion of the ligamentum arteriosum. It is probably associated with, or is perhaps due to, a short ligamentum arteriosum.

(2) A typical roentgenographic appearance is presented which must be differentiated from aortic aneurysm, coarctation, mediastinal tumor, and patent ductus arteriosus.

(3) Postero-anterior and lateral roentgenograms with lateral planigrams will provide proof of the diagnosis in most cases. Angiocardiography or retrograde aortography may be utilized if further clarification is necessary.

(4) Roentgenographic evidence of buckling is accentuated by the degenerative changes of senescence.

(5) A precordial systolic murmur is the only associated objective finding. The patients are asymptomatic and need no treatment.

ACKNOWLEDGMENT: The author is indebted to Herbert L. Abrams, M.D., of Stanford University for allowing the use of CASE IV.

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SUMMARIO IN INTERLINGUA

Buclage Del Arco Del Aorta (Pseudocoarctation, Plicatura): Un Entitate Roentgenographic

Buclage del aorta es un rar anomalia congenite in le curso e le profilo del arco aortic que occurre al nivello del insertion del ligamento arteriose. Illo es probabilemente associate con un ligamento arteriose troppo curte, e isto es forsan su causa.

Es presentate un typic apparentia roentgenographic. Isto debe esser differentiate ab aneurysma aortic, coarctation, tumor mediastinal, e patente ducto arteriose. Roentgenogrammas postero-anterior e lateral con planigrammas prova le diagnose in le majoritate del casos. Angiocardiographia o aortographia retrograde pote esser utilisate si un clarification additional es necessari. Le evidentia roentgenographic de buclage aortic es accentuate per le alterationes degeneratori del senescentia.

Un murmure systolic precordial es le sol associate constatation objective. Le patientes es asymptomatic e require nulle tractamento.

Cystic Degeneration in Glioblastoma Multiforme: Trapped-Air Sign[1]

GWILYM S. LODWICK, M.D.

THE SIGN IN roentgen diagnosis is born when certain details of the roentgenogram are repeatedly found to bear a positive correlation to a given clinical diagnosis. A sign springs, then, from regular follow-up of the patient to the operating room or the autopsy laboratory, where puzzling or poorly understood roentgen findings can be explained in terms of the underlying pathologic anatomy. Such signs are almost never 100 per cent accurate; further, their presence may be entirely of academic interest, since the final diagnosis is often promptly established by other means. It is always challenging and stimulating, however, to attempt to push the diagnostic frontier as far as possible; also, the roentgen sign occasionally permits redirection of therapy into more appropriate channels. To this end, this paper will describe a roentgen sign of glioblastoma multiforme, namely, the presence of trapped air within multiple small, uneven cysts in the center of the tumor. Two cases illustrative of this sign will be reported.

MATERIAL

While a Fellow in the Registry of Radiologic Pathology, Armed Forces Institute of Pathology, the author collected the roentgenograms from 500 cases of primary tumor of the brain and spinal cord to be screened for accessioning in the Registry. In each case the clinical history, the gross and histologic findings, and the roentgenograms were carefully related. In 3 instances, multiple radiolucencies, interpreted as bubbles of gas within brain substance, were observed in the ventriculograms. The histologic diagnosis in each of these 3 cases proved to be glioblastoma multiforme. Observation of this sign in 3 additional cases has proved its usefulness.

ILLUSTRATIVE CASES

CASE I (Armed Forces Institute of Pathology): A 52-year-old white male complained of headaches, lethargy, stupor, and right homonymous hemianopsia of two months duration. A ventriculogram was interpreted as showing pronounced displacement of the ventricular system to the right. Multiple gas-filled cysts were visualized in the left parietal region (Figs. 1 and 2).

At operation a large tumor was removed from the left temporoparietal area. Multiple hemorrhagic areas were present. *Histologic diagnosis:* Glioblastoma multiforme.

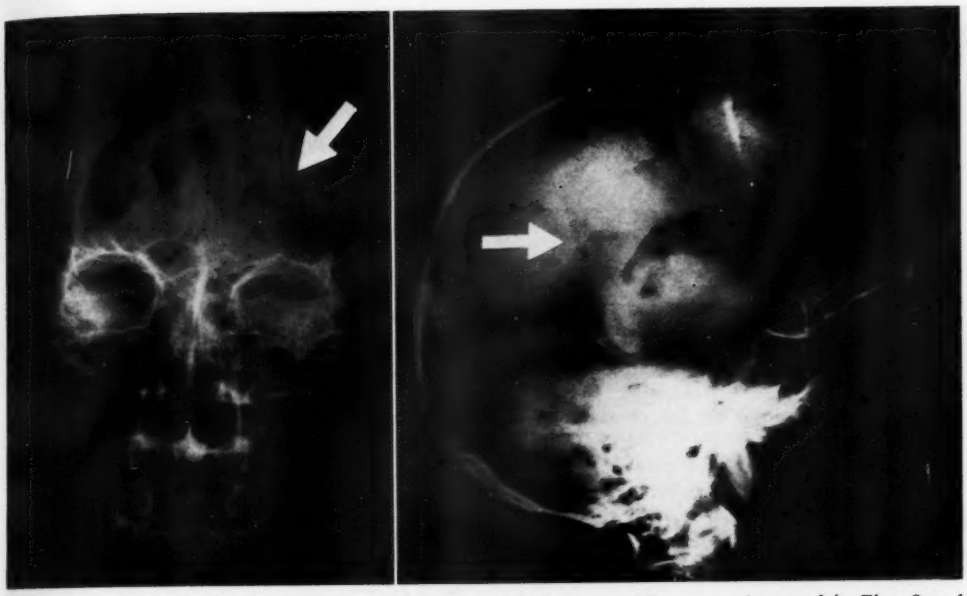
CASE II (State University of Iowa). B. S., a white woman aged 68, complained of difficulty in swallowing. Three months previously her husband had noticed that she was having difficulty in thinking of words. Shortly thereafter severe headaches and right-sided weakness developed and, somewhat later, vomiting and difficulty in swallowing. Physical examination showed right homonymous hemianopsia, right hemihypesthesia, and severe right hemiparesis with spasticity. An electrocardiogram indicated an abnormal focal process, possibly due to an expanding lesion in the left temporal region. Spinal fluid protein was 178 mg. per cent.

An initial tap of the left lateral ventricle, after occipital placement of burr holes, was unsatisfactory. On a second tap, however, a very small amount of bloody fluid was withdrawn and replaced with air. The right lateral ventricle was tapped without difficulty, and 10 c.c. of fluid withdrawn and replaced with air. When this was done, bubbles of air came out of the left burr hole.

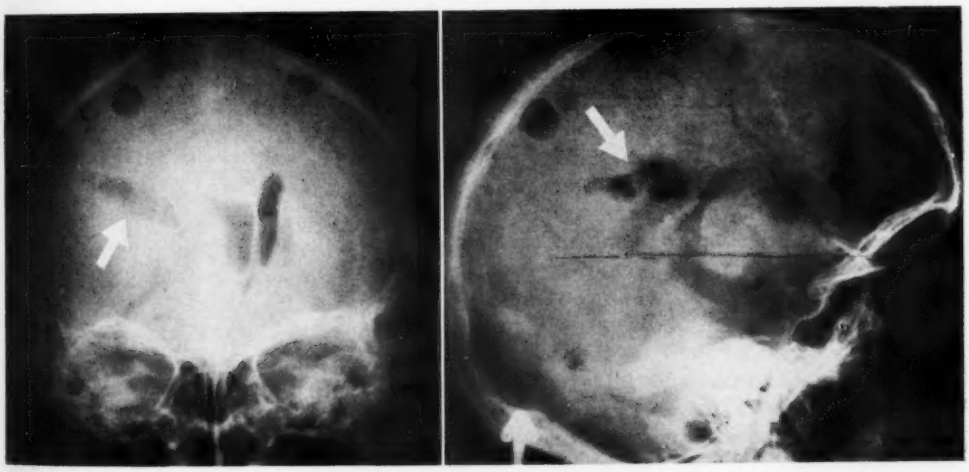
Routine roentgenograms of the chest and skull were negative. The ventriculogram was interpreted as showing pronounced displacement of the ventricular system to the right side. Cysts in the left parietal area were filled with gas (Figs. 3 and 4).

At operation, a left parietal flap was raised. The dura was quite tense. A small nick was made in the wound, and a cavity containing air under some pressure was entered. The tumor proved extensive and extremely vascular. The patient survived the operation for five months. *Histologic diagnosis:* Astrocytoma Grade II (Kernohan). Glioblastoma multiforme, usually Grade III or Grade IV (Kernohan), is characterized by histologic variability and an abrupt clinical course, as in this case.

[1] From the Department of Radiology, University of Missouri, School of Medicine, Columbia, Mo. Accepted for publication in July 1957.



Figs. 1 and 2. Case I. Postero-anterior and lateral ventriculograms. The arrows here and in Figs. 3 and 4 indicate the cystic areas within the tumor.



Figs. 3 and 4. Case II. Anteroposterior and lateral ventriculograms.

DISCUSSION

The presence of gas bubbles within the tumor substance can be explained by the fact that this rapidly growing tumor becomes necrotic centrally, forming fluid-filled cysts, which intercommunicate (Fig. 5). If during ventriculography the needle passes through the tumor, the needle tract from the ventricle to the tumor provides a route for displacement of fluid from the degenerative cysts and replacement by gas (Case II). In addition, direct injection of gas into the cysts may occur.

While such cysts are a common pathologic finding in glioblastoma multiforme, their demonstration by ventriculography is unusual. This is due to the fact that they are demonstrated only when they lie

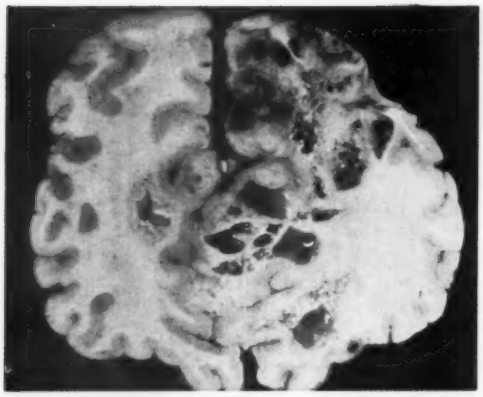


Fig. 5. Gross coronal section through cerebral hemispheres. Glioblastoma multiforme with extensive cystic degeneration.

in the path of the ventricular needle. The majority of such tumors are too deep-seated or so located as not to be penetrated by the needle.

Other cystic lesions which can trap air during ventriculography, and which must be excluded in differential diagnosis, are:

1. Neoplastic
   (*a*) Slowly growing gliomas, astrocytoma, oligodendroglioma. These form single large, more regularly outlined cysts (1*a*), in contradistinction to the multiple smaller cysts of glioblastoma multiforme.
   (*b*) Hemangioblastoma. Single large cysts, cerebellar location (1*b*).
   (*c*) Intracranial epidermoid. Streaky, irregular patterns of gas over the surface and in the convolutions of the tumor, principally intraventricular location (2).
   (*d*) Cystic teratoid tumors. Usually unilocular, cerebellar, or deep-seated in location.
2. Inflammatory
   (*a*) Brain abscess. Often in the temporal and cerebellar regions, and usually unilocular (3). Differential diagnosis would be predicated upon clinical history and findings.
3. Miscellaneous
   (*a*) Porencephalic cysts. Communicate with ventricle.
   (*b*) Leptomeningeal cysts. Located on surface of brain.
   (*c*) Cavum septi pellucidi. Mid-line.
   (*d*) Hydatid cyst. Smooth, unilocular.
   (*e*) Colloid cyst. Mid-line, third ventricle.

SUMMARY AND CONCLUSION

Glioblastoma multiforme frequently undergoes central liquefaction necrosis to form multiple cysts. These cysts may fill with air during ventriculography, when the needle tract passes through the tumor. This "trapped-air sign" of multiple small cysts has proved helpful in localizing the tumor and in providing the diagnosis.

NOTE: The author is indebted to Col. Wm. L. Thompson of the Armed Forces Institute of Pathology and to Dr. Eugene F. Van Epps of the State University of Iowa for permission to use their material, and to Dr. John P. Dorst for his assistance.

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SUMMARIO IN INTERLINGUA

Degeneration Cystic In Glioblastoma Multiforme: Signo De Aere Trappate

Glioblastoma multiforme disveloppa frequentemente necrosis a liquefaction central con le formation de cystes multiple. In ventriculographia, quando le agulia aperi un via a transverso le tumor, il pote occurrer que ille cystes es replenate de aere. Iste "signo del aere trappate" in multiple cystes de micre dimensiones se ha monstrate de adjuta in le localisation del tumor e in le establimento del diagnose.

A Simplified Technic for Nephrotomography[1]

DAVID A. VAN VELZER, M.D., and RAYMOND R. LANIER, PH.D., M.D.

THE TERM "nephrotomography" as first used by Evans *et al.* (1) refers to body-section roentgenography performed during the nephrographic stage of visualization of the renal parenchyma. This occurs approximately ten to twelve seconds after a two-second injection of 50 c.c. of 70 per cent Urokon through a large-caliber needle in an antecubital vein. By this method the arterial supply to the kidneys and, in fact, all of the major branches of the abdominal aorta can be visualized. A plain anteroposterior film of the abdomen is taken, after a predetermined circulation time, to visualize the renal arteries, followed immediately by another anteroposterior film to show the nephrogram. This, in turn, is promptly followed by a tomogram through the kidney at a depth determined by a preliminary film. The whole procedure, from the time of injection through the third exposure, takes approximately twenty-five seconds.

The procedure of Evans *et al.* (1, 2) required a cut-down on an antecubital vein and the insertion of a Robb-Steinberg 12-gauge angiocardiographic needle. The arm-to-tongue circulation time was determined by means of Decholin. Evans also included Decholin in the 50 c.c. of 70 per cent Urokon to obtain additional evidence for timing should subsequent injections be indicated. We have modified this procedure by using percutaneous introduction of a 13-gauge needle into an antecubital vein with the help of local Novocaine anesthesia. This eliminates the necessity for a surgical procedure and the sacrificing of the vein.

We have also found the use of Decholin extremely unsatisfactory for determination of circulation time and have used I^{131} instead. The time required for 5 to 10 microcuries of I^{131} to reach the kidney region from the arm is determined by a scintillation counter centered over the lumbar area. This technic affords an accurate prediction of the time at which the exposures for the arterial and nephrographic phases should be made. In the absence of this determination, an arbitrary period of eleven seconds for the circulation time may prove satisfactory in some cases. If this estimate is incorrect, changes can be made for subsequent injections.

TABLE I: RESULTS OF NEPHROTOMOGRAPHY

Total number of cases	34
Total with present technic (one big needle)	20
Arterial visualization	15
Diagnostic arterial visualization	7
Diagnostic nephrogram	34
Number of severe reactions	0
Number with minor reactions (flushing, arm pain, etc.)	15

To date we have performed 34 nephrotomograms (Table I). Of these, approximately 14 were done early in our experience, when the present technic was not fully developed. At first we used two smaller needles, one in each arm. With this method, the dilution of contrast material was too great, due to the prolonged time necessary for the injection, and the stage of arterial visualization was not obtainable. The nephrographic phase of visualization, however, could be accomplished. Of 20 cases done with the present technic, 15 showed the renal arteries. In only 7 of these, however, were the films of diagnostic quality. The failure to obtain good demonstration of arterial filling in a high percentage of cases was attributable to the necessity of precise timing to catch this momentary phenomenon. A variance in timing of radiography of one or two seconds will result in nonvisualization. It was for this reason that we developed and now employ the tracer technic.

[1] From the Department of Radiology, University of Colorado Medical Center, Denver, Colo. Accepted for publication in July 1957.

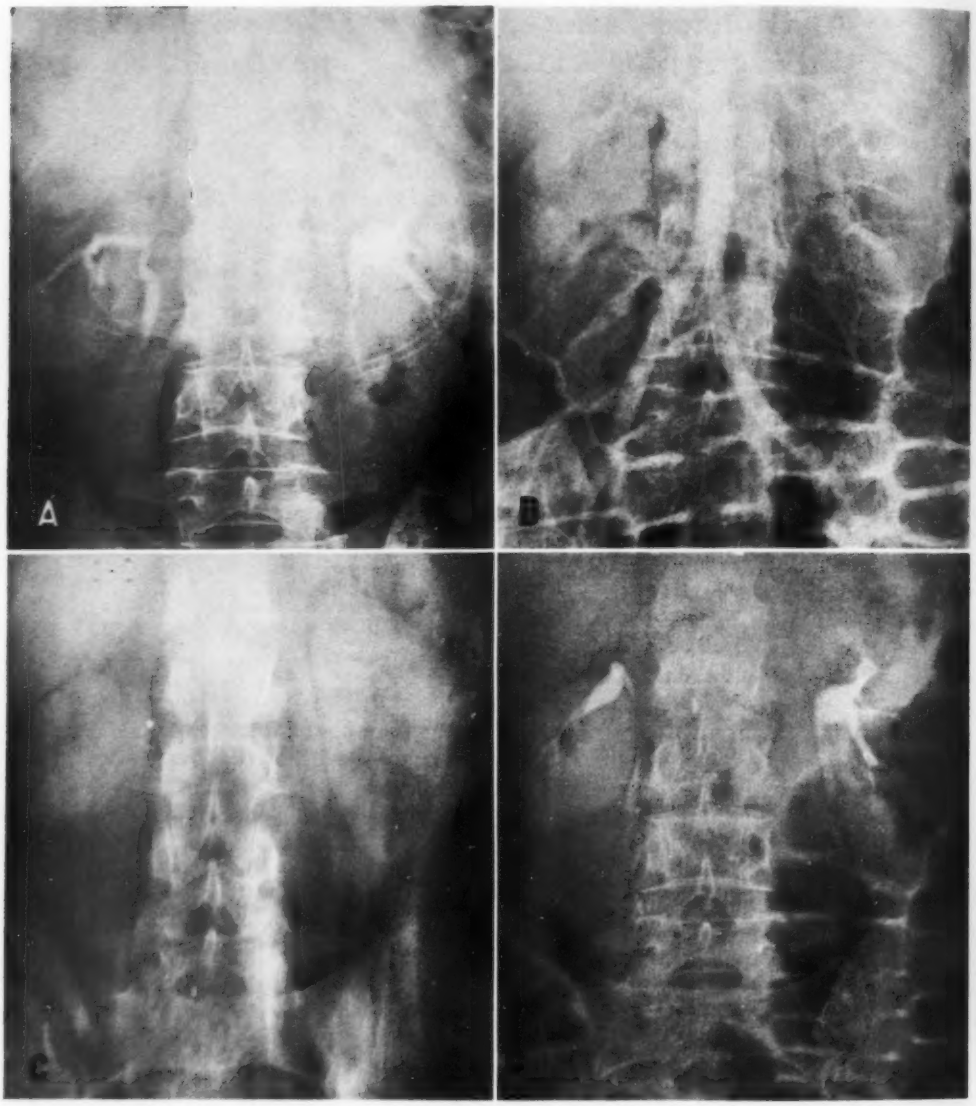

Fig. 1. A. Intravenous pyelogram suggesting a lesion in the upper pole of the right kidney.
B. First film during nephrotomography, demonstrating the degree of visualization of the abdominal aorta and its branches possible by this technic. No abnormal vessels in the region of the right kidney are seen.
C. A tomogram during the nephrographic phase of renal visualization, showing a normal left kidney and what appears to be a small right kidney.
D. Subsequent film, still in the nephrographic phase, revealing the right kidney to be partially supported by the attachment of the ureteropelvic structure. No evidence for tumor or cyst is seen.

Indications for nephrotomography are fourfold and are of great clinical significance: (*a*) to differentiate between renal cysts and neoplasms, (*b*) to study the characteristics of the blood supply to the kidneys, (*c*) to estimate renal function, and (*d*) to substantiate data in question because of inconclusive intravenous or retrograde pyelograms.

Contraindications are approximately the

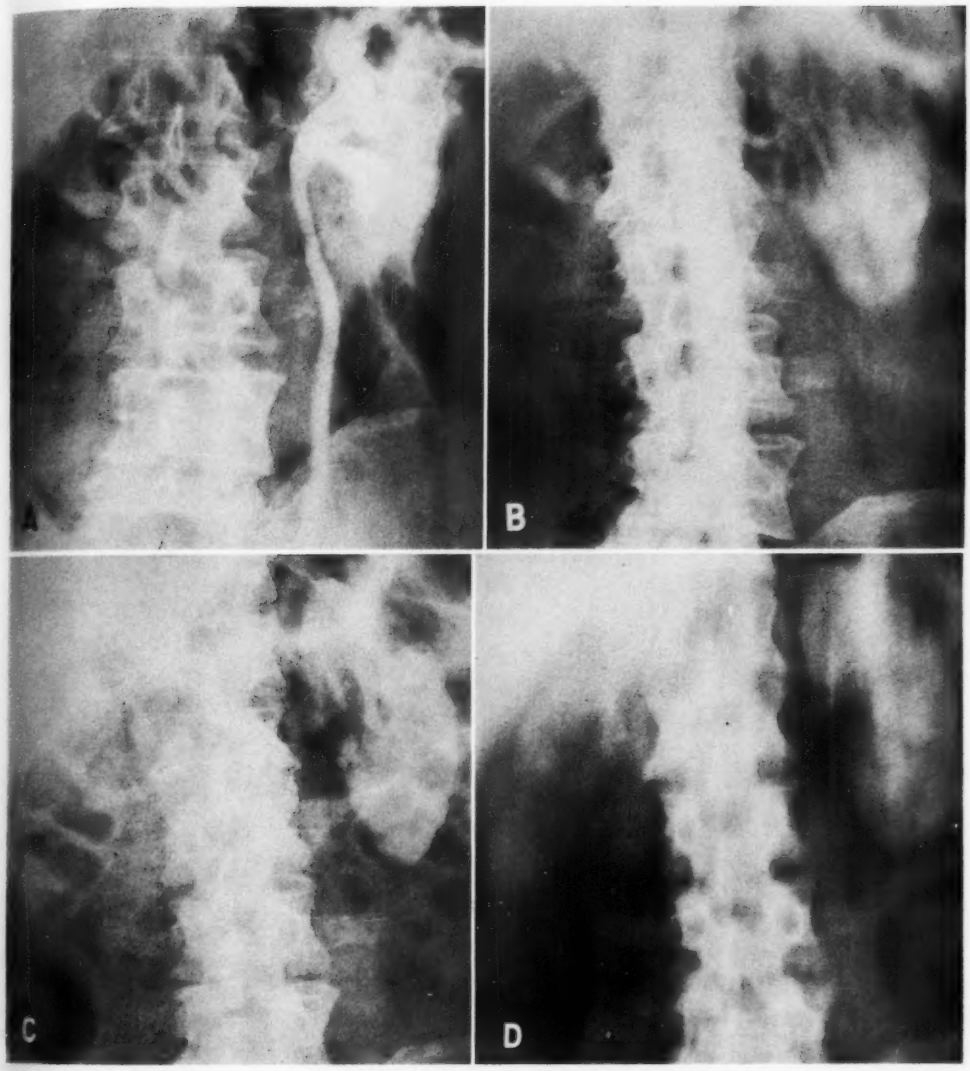

Fig. 2. A. Intravenous pyelogram revealing a nonfunctioning right kidney. Chronic pyelonephritis on the left.
B. Arteriographic phase of renal visualization. The left renal artery appears normal. The right renal artery is straight and of smaller caliber than the left and lacks the arborization normally seen. This indicates poor renal function.
C. Nephrographic stage, normal on the left. On the right the image is not as dense and shows a smaller kidney.
D. Third film in the sequence, a tomogram taken during the nephrographic phase of renal visualization. The anatomical changes are more clearly shown.

same as for intravenous pyelograms: (*a*) iodine sensitivity, (*b*) history of severe allergy, (*c*) marked impairment of renal function.

In none of the cases in our series was there a severe reaction. The usual symptoms of transient pain in the arm, lightheadedness, warmth, and flushing, which may be seen in routine pyelography, were encountered. In one case three urticarial blebs appeared a few minutes after the injection, but these disappeared promptly

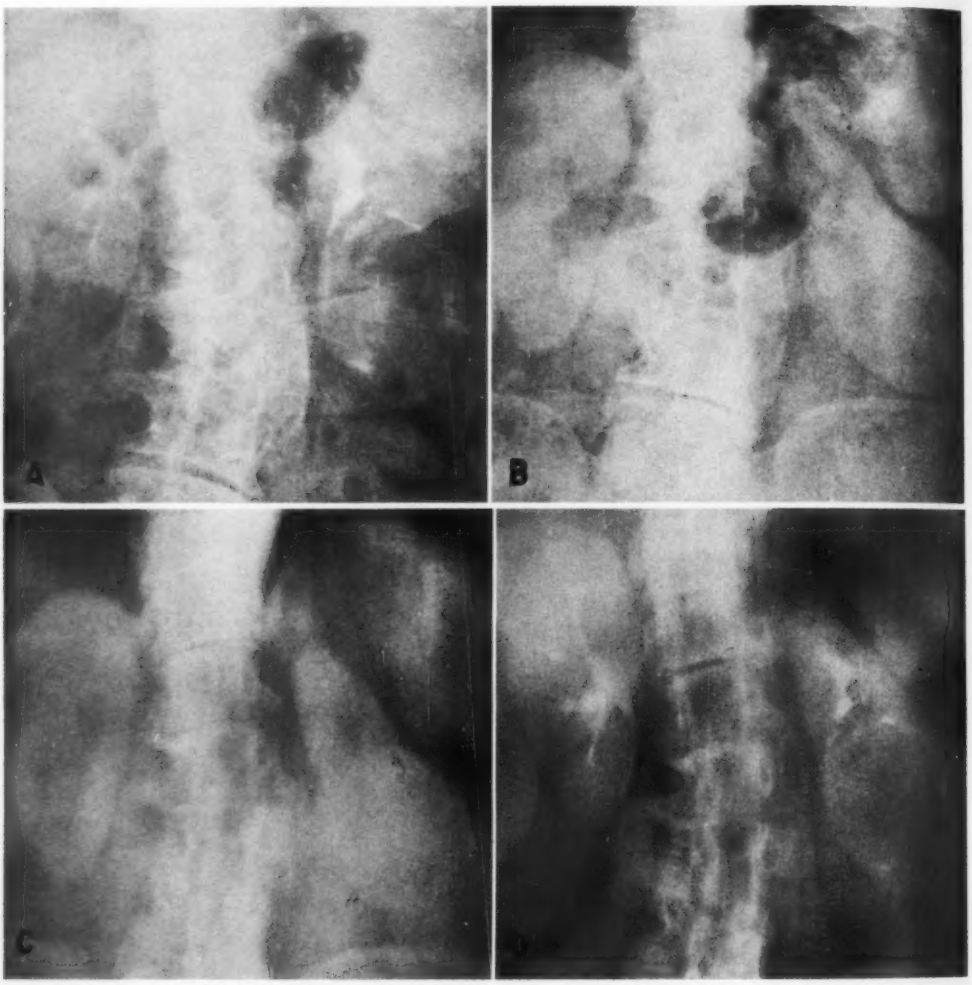

Fig. 3. A. Intravenous pyelogram revealing a mass in the lower pole of the left kidney.
B. First film during nephrotomography, showing the mass in the lower pole on the left.
C. Beginning evidence that the mass is a cyst.
D. Nephrogram during the excretory phase, clearly showing the cyst.

following administration of an antihistamine.

CASE REPORTS

CASE I: A. T., a 78-year-old female, was admitted to the hospital because of left chest pain, anorexia, shortness of breath, and weight loss.

An extensive investigation for a possible malignant tumor was undertaken. Laboratory examinations were normal. An intravenous pyelogram (Fig. 1, A) revealed a distortion of what appeared to be the superior calyces of the right kidney, and a radiographic diagnosis was made of possible neoplasm. Nephrotomography (Fig. 1, B, C, and D) was undertaken in an effort to demonstrate the arterial supply to the suspected tumor. The examination showed no evidence for a renal or retroperitoneal neoplasm. It was apparent that the kidney was tilted forward and rotated about its transverse axis, apparently hanging by the renal vessels and pelvis. There was no evidence indicating a cyst. The patient subsequently died and postmortem examination revealed a large capsular cyst, having no intrinsic renal component, on the upper pole of the right kidney, tilting it forward. The illustrations of this case demonstrate the clarity with which abdominal arteries can be seen.

CASE II: C. M., a 56-year-old male with pelvic pain, gave a history of chronic pyelonephritis. A diagnosis of carcinoma of the prostate had been made two years earlier. There had been a 25-pound weight loss in the four months prior to admission. Urinalysis revealed albuminuria (4+) and many red blood cells. Acid and alkaline phosphatase were within normal limits. Urine culture produced a heavy growth of *Pseudomonas aeruginosa*. Blood urea-nitrogen was 23.5 mg. per cent. The white blood count was 25,350 with 99 per cent polymorphonuclears. Pyelography (Fig. 2, A) revealed caliectasis and ureterectasis on the left, with no evidence of function on the right. A mass in the bladder seen on both intravenous pyelography and cystoscopy proved to be a transitional-cell carcinoma.

A nephrotomogram (Figs. 2, B, C, and D) demonstrated a small, slightly functioning right kidney. This case illustrates the correlation between the small caliber of the right renal artery, its lack of tortuosity, and poor renal function.

CASE III: B. D., an 83-year-old female, entered the hospital with thrombophlebitis and diverticulitis of the colon. Review of the past history revealed "kidney trouble" several years previously. An intravenous pyelogram (Fig. 3, A) showed a rounded lesion in the lower pole of the left kidney suggestive of a cyst or tumor. Urinalysis was normal.

Nephrotomography (Figs. 3, B, C, and D) revealed a radiolucent ischemic mass in the lower pole of the left kidney diagnostic of a renal cyst. Subsequently, films made eight years before became available and showed the lesion to have been present at that time, without change in size or shape. The eight-year follow-up was considered to be sufficient proof of benignity.

CONCLUSIONS

Nephrotomography is a simple method for studying the morphology and blood supply to the kidneys. Its main use is to differentiate renal cysts from neoplasms. The critical arteriogram is not absolutely necessary but is of aid in this differentiation. A good idea of the functional state of the kidney can be obtained from the demonstration of the renal vessels. Any intra-abdominal cancer with a large blood supply could be seen in this manner.

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SUMMARIO IN INTERLINGUA

Un Simplificate Technica Nephrotomographic

Le autores describe un simplificate technica nephrotomographic le qual provide visualisation del arteria renal, un nephrogramma, e un tomogramma a transverso le ren a un profundor determinate per un exposition preliminari. Un sol injection de 50 cm³ de 70 pro cento de Urokon es effectuate per medio de un agulia (de calibre no. 13) introducite percutaneemente a in un vena antecubital. Isto es sequite per le completion del tres expositiones in rapide succession. Le tempore de circulation es determinate per medio de un contator de scintillation que es centrate supra le area lumbar post le injection de 5 a 10 microcuries de I^{131}.

Le resultatos obtenite in 34 casos es tabulate. Studios de tres casos es reportate in detalio. Reactiones sever non esseva incontrate in ulle caso.

Le uso de iste technica es indicate quando il se tracta (1) de differentiar inter cystes e neoplasmas renal, (2) de studiar le characteristicas del provision de sanguine al renes, (3) de estimar le function renal, e (4) de verificar datos basate super le examine de inconclusive pyelogrammas intravenose o retrograde.

The Laminagraphic Appearance of Ectopic Right Upper Lobe Bronchi[1]

SAUL SCHEFF, M.D., S. A. KAUFMAN, M.D., and GEORGE LEVENE, M.D.

ECTOPIC OR supernumerary bronchi arising from the right side of the lower trachea are uncommon but not rare. Since such anomalies may not be readily recognized on bronchoscopic or surgical exploration, prior knowledge of their existence is important to the thoracic surgeon. During the study of patients with intrathoracic problems laminagraphy is often the first specialized examination. With this technic we have been impressed by the demonstration of variations in the origin of the right upper lobe bronchi. In a year, 3 cases of an anomalous take-off of a right upper lobe bronchus from the right lower trachea have been encountered. To forewarn the surgeon of such an anomalous bronchus is to forearm him, since this variant has been erroneously identified as the eparterial bronchus at operation and may be entirely overlooked at bronchoscopy.

It is not the purpose of this paper to delve into the origin of the variations possible in the anomalous bronchi observed running to the right upper lobe (4, 5). Whether these are supernumerary, supplying an additional segment of lung tissue, or whether they are merely displaced from their usual course, is a problem that is difficult to decide even with the gross specimen at hand. Specialized injection methods to delineate all of the normal segments of lung and their corresponding bronchi are needed to determine whether a variant is really supernumerary or merely ectopic. The latter occurrence is seen more often and is being recognized on bronchograms with increasing frequency. Boyden and Scannell (2), among 50 right upper lobes, found a true trifurcation in only 46 per cent, and in the remaining 54 per cent either a bifurcation or four orifices. We could find no mention or demonstration of an aberrant bronchus arising from the left lower trachea.

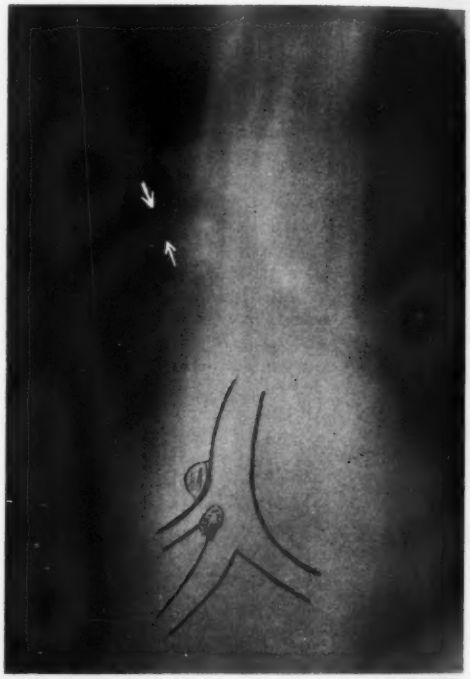

Fig. 1. A. C., a 63-year-old male, was examined because of hemoptysis. The aberrant bronchus is seen to arise from the right lower trachea with the azygos vein above and a calcified node below. At bronchoscopy the orifice of this bronchus was visualized and identified. No cause could be found for the hemoptysis and the patient was discharged. He has remained asymptomatic.

The bronchoscopic and bronchographic appearance of the variants of the right upper lobe have been well described (3, 1). Of especial interest to us has been the laminagraphic appearance of a bronchus arising 1.0 to 2.5 cm. above the carina, from the distal portion of the right side of the trachea. This is demonstrated in Figure 1, with the azygos vein lying above and an enlarged node lying below. That these neighboring structures are not essential to the demonstration is illustrated in Figure 2; here the aberrant bronchus is seen lying some distance cephalad to the

[1] From the Department of Radiology of the Massachusetts Memorial Hospitals and Boston University School of Medicine, Boston. Accepted for publication in July 1957.

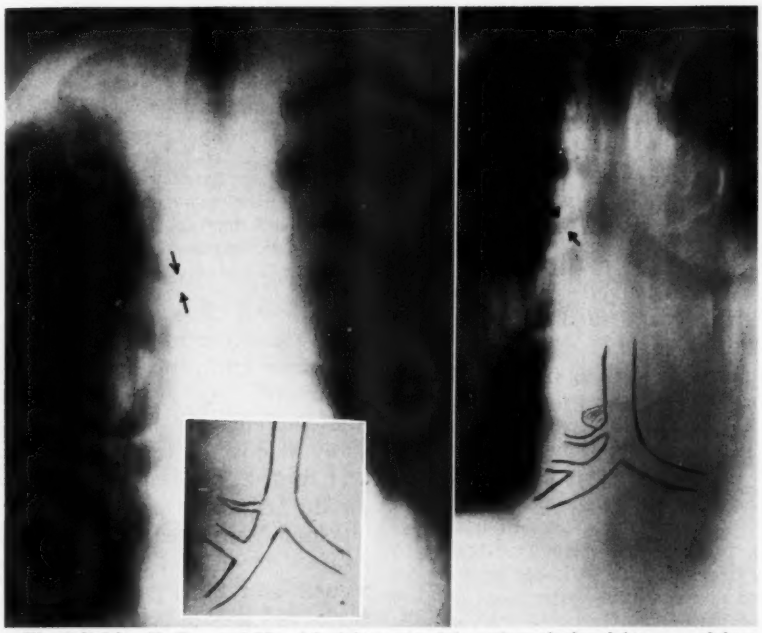

Fig. 2 (left). F. T., aged 55, with right upper lobe tuberculosis; right upper lobectomy. The aberrant bronchus arising some distance above the eparterial bronchus on the right is shown. The anomaly was unrecognized at bronchoscopy. At operation the orifice was first believed to represent the right upper lobe bronchus.

Fig. 3 (right). J. B., aged 67, with recurrent mottled densities in both lung fields. The laminagram demonstrates the aberrant bronchus well. This was overlooked at the time of original bronchoscopy but was recognized at repeat examination after laminagraphy had demonstrated the ectopia.

eparterial bronchus which forms the chief airway to the right upper lobe. Re-examination of the plain chest films after demonstration of the ectopic bronchi by planigraphy failed to disclose the anomaly.

SUMMARY

Attention is called to the laminagraphic appearance of an anomalous bronchus to the right upper lobe arising from the distal end of the trachea. It is important to recognize this variation so that it can be properly identified at the time of bronchoscopic examination and during surgical exploration.

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SUMMARIO IN INTERLINGUA

Apparentia Laminographic De Ectopic Bronchos Del Lobo Dextero-Superior

Es signalate le apparentia laminographic de un broncho anormal que duce al lobo dextero-superior e se origina ab le extremitate distal del trachea. Il es importante recognoscer iste variation de maniera que illo pote esser identificate correctemente al tempore del examine bronchoscopic e in le curso del exploration chirurgic.

Fatal Uremia Due to Uric Acid Crystals in a Case of Lymphosarcoma[1]

MARY S. FISHER, M.D., ANTHONY V. TORRE, M.D.,[2] and GEORGE T. WOHL, M.D.

ONE OF THE RARE and partially avoidable complications of the lymphoma group of neoplasms is uremia as the result of precipitation of uric acid in the urinary tract. This has received considerable attention in the general medical and hematological literature, but is perhaps not sufficiently well known to the radiologist. A recent example at the Philadelphia Veterans Administration Hospital focused our attention upon it.

C. O'H. , a 24-year-old white male, was admitted on May 16, 1956, with a one-month history of hematemesis, anorexia, and weight loss totaling 50 pounds. An epigastric mass had been apparent for two days, and this was the sole significant physical finding. The hemoglobin was 12.0 gm. and the white blood cell count was normal. Urinalysis showed an alkaline urine containing 2+ albumin and 50 to 60 red blood cells per high-power field. An initial blood urea nitrogen of 55 mg. per cent rose in two days to 80 mg. per cent, in spite of fluid therapy. An upper gastrointestinal series showed a completely rigid stomach with absence of peristalsis. The gastric outline, however, was generally normal and the mucosal pattern intact, with the exception of an ulceration on the lesser curvature aspect of the antrum. Esophagus and duodenum were normal.

At surgery, May 18, 1956, a nonresectable mass involving the entire stomach, with fixation to the hepatoduodenal and gastrohepatic ligaments, was found. Frozen-section diagnosis was lymphosarcoma, and the patient was promptly removed to the x-ray therapy department, where treatment was started through a single 18 × 20-cm. anterior mediastinal and upper abdominal field. Seven treatments in seven days, in increments of 200 r in air per day (after the initial two treatments of 150 r each) resulted in an air dose of 1,250 r and a tumor dose of 660 r (250 kv, h.v.l. 1.35 mm. Cu, distance 50 cm.).

The mass disappeared after the third treatment, but oliguria, which developed on the day after surgery, never improved. On May 23, 1956, there was a sudden onset of auricular tachycardia and pulmonary edema, and death ensued two days later.

Autopsy showed a somewhat distorted abdominal cavity, but an estimated 95 per cent of the tumor cells had disappeared. Both ureters were occluded by uric acid crystals. The kidneys showed no evidence of lymphomatous infiltration or pre-existing disease.

It is well known that urinary complications can occur in the lymphomas because of tumor infiltration of the kidney parenchyma (6). Less commonly appreciated is the complication of which the above case is an example. It may be explained (10, 11) by the fact that uric acid is the end-product of purine metabolism, the increased nucleoprotein breakdown resulting in increased blood and urine uric acid. Weisberger and Persky (11) collected a large series of cases of lymphoma and found an incidence of uric acid calculi of 5.3 per cent. This was seventy-five times that of the general hospital population. In a group of comparable size with malignant growths of other types, the incidence was zero. This series included both treated and untreated patients. The process may be exacerbated by treatment, either because of accelerated destruction of neoplastic cells or because of inhibition of production of cells (10).

The necessary steps to prevent or minimize this occurrence include primarily a recognition of its possibility and a careful evaluation of kidney status, including blood and urine uric acid, both before and during therapy. High fluid intake, low purine diet, alkalinization of the urine, and the use of cinchophen have been recommended (3, 6) as prophylactic measures, with catheterization of the ureters to relieve obstruction and the use of antibiotics if the complication occurs.

The history of the phenomenon is of more than ordinary interest. The in-

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creased uric acid output in leukemia was observed as long ago as 1870 (9). Hall and Whipple (2) cited a German radiologist who in 1905 recorded increased uric acid in the urine after treatment for eczema (sic !). In 1923, Naegeli (8) commented on the frequent occurrence of uric acid stones in myeloid leukemia, and Lennox and Means (5) observed abnormal elevation of the blood uric acid during the course of roentgen therapy in a case of acute leukemia. Six years later, Bedrna and Polčak (1) reported 2 cases of uric acid stone obstruction, treated and relieved, after roentgen treatment of leukemia, one lymphatic and one myeloid. Merrill, *et al.* (6, 7) reported several cases. Lear and Oppenheimer (4) documented a case of chronic lymphatic leukemia, with uric acid crystals in the urine before treatment, in which the white blood cell count fell from 475,000 to 45,000 in two months after 50 r whole-body radiation front and back in twelve days. Blood uric acid rose to 15.8 mg. per cent and the patient died of kidney sepsis although the urine output was maintained.

In 1953 Weisberger (11) reviewed the subject, indicating that 15 cases of uric acid uremia had been reported during or after therapy. These included 13 of leukemia, 1 of lymphosarcoma, and 1 of Hodgkin's disease. He reported 2 more, 1 of lymphosarcoma after nitrogen mustard, the other of myeloid metaplasia without treatment. In 1956 Sandberg, Cartwright and Wintrobe (10) carefully demonstrated the increased uric acid excretion in the leukemias (except the chronic lymphocytic) with and without therapy, including a case of acute leukemia under steroid treatment, where the uric acid output rose as the white blood cell count fell.

SUMMARY

The occurrence in the lymphomas of increased blood and urine uric acid levels, with uric acid stone formation and uremia, has been discussed and the history reviewed. This may occur with or without therapy, and may be exacerbated by any therapy which increases cell breakdown. Prophylactic measures necessary to prevent its rare fatal termination have been reiterated. A third such instance occurring in lymphosarcoma has been reported.

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SUMMARIO IN INTERLINGUA

Uremia Mortal, Causate Per Crystallos De Acido Uric In Un Caso De Lymphosarcoma

Es reportate un caso de lymphosarcoma abdominal in que le morte, occurrente post roentgenotherapia, esseva causate per uremia resultante del precipitation de acido uric in le vias urinari. Al necropsia, estimatemente 95 pro cento del cellulas tu-

moral habeva disparite e le renes monstrava nulle signo de infiltration lymphomatose o de un morbo pre-existente, sed ambe ureteres esseva occludite per crystallos de acido uric.

Le punctos a observar pro prevenir o reducer le signification de iste occurrentia include, in general, le recognition de su possibilitate e le meticulose evalutation del stato renal e, particularmente, alte ingestion de fluido, dieta a basse contento de purina, alcalinisation del urina, e le uso de cinchopheno in combination con catheterisation del ureteres pro alleviar le obstruction e le uso de antibioticos si le complication ha occurrite.

Le historia del phenomeno es passate in revista.

File Room Operation in a Radiology Department[1]

JEROME H. SHAPIRO, M.D.,[2] and HAROLD G. JACOBSON, M.D., F.A.C.R.[3]

IT IS OUR OBJECT in this brief paper to outline several facets of the operation of a file room in a busy radiology department in a general hospital. While we do not claim that our methods are novel, ingenious or even original, we believe that an account of them may be helpful to others.

Basically, our file room procedures, which begin with the completely processed roentgenograms and end with their distribution to the radiologists for interpretation, consist of two important spheres of operation. These are: the sorting of the processed roentgenograms and their distribution for interpretation.

THE SORTING OPERATION

We have modified the vertical sorting system described in *Planning Guide for Radiologic Installations* (1), and currently in use at the Johns Hopkins Hospital Department of Radiology and other institutions. This vertical sorting system consists of three tiers of bins (Fig. 1) numbered from left to right 00–99. Each set of numbers refers to a group of 3 vertical tiers in sequence. The designating numbers represent the last 2 digits of the x-ray number. The bins run horizontally for 8 1/2 feet and are 5 1/2 feet high.

In our department we have 33 of these bins on a horizontal level. The uppermost row of bins is a potential repository for recently processed films. The middle bin in the vertical tier is for the completed case, preparatory to its distribution for interpretation. The lowermost bin is designed to hold those completely sorted roentgenograms for which the regular x-ray jackets are not immediately available. In addition to the usual permanent x-ray jacket, on which are the patient's name and x-ray number, as well as the type and date of each examination, a work jacket is used, with different colored print to designate the source of the examination. Thus, blue represents outpatients and ward cases; green, private and semiprivate patients; purple, neuroradiologic cases; red, fluoroscopic examinations, etc. These work jackets are made of strong but cheap burlap paper, so that they may be used repeatedly, up to 56 times, both sides being available for use. As will be seen from Figure 2, provision is made for listing

Fig. 1. Frontal view of a segment of the sorting bins. The uppermost tier contains envelopes awaiting new roentgenograms. In the middle tier are located the completed cases ready for distribution. Work jackets of cases lacking the permanent envelope are present in the lowermost tier.

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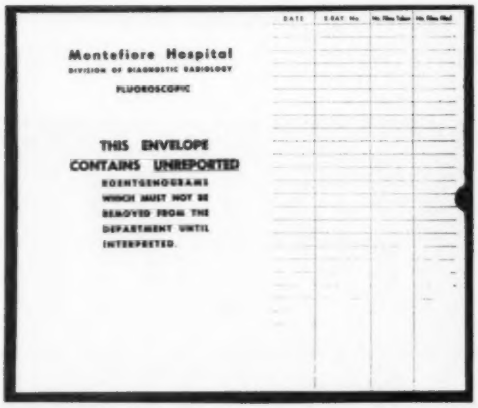

Fig. 2. Sample work jacket. Colored print is used to identify the source of the case.

the date, x-ray number, number of roentgenograms exposed, and number of roentgenograms filed on each side of the work jacket. The film-sorting clerk, at the initiation of her work, places the work jacket and permanent jacket in an upper bin under the proper number. She then places the x-ray request in the work jacket and tabulates on the latter the number of exposed roentgenograms available on the particular case as these are deposited in the work jacket. When the number of roentgenograms in the work jacket equals the number of roentgenograms requested, the case is complete and is ready for the next sequence of operations. If the regular (permanent) jacket is in the file, then both it and the work jacket are placed in the middle bin under the same number sequence. If the permanent jacket is not in the x-ray file, then the work jacket is placed in the third tier, under the same number sequence. Such work jackets remain in the third tier for a varying period of time, at the discretion of the radiologist.

DISTRIBUTION

In effect, another vertical file system is used for distribution of the films for interpretation, the various types of cases being placed in individual box categories, according to source, with the sources clearly indicated (Fig. 3). Again, the position of private, semiprivate, ward and outpatient

Fig. 3. View of bins containing films ready for interpretation, with the tabulating board seen on its side.

cases, as well as specialized fluoroscopic procedures, etc., is clearly indicated in different bins. The use of the varicolored work jackets permits rapid sorting into the proper receptacles. Each case, including the temporary work jacket which contains the uninterpreted roentgenograms, the x-ray request, and a copy of previous reports, together with the permanent jacket, is placed in the individual bin corresponding to the proper source, and in orderly number sequence. This sequence is recorded on a tabulating board (Fig. 4) in exactly the same order as that in which the cases are placed in the respective bins. As cases are distributed to, or picked up by the individual radiologist, his initials are placed on the tabulating board. Should cases be kept for conferences by any of the radiologists, this information, including the type of conference, is also noted on the board.

Upon completion of his interpretation of a given case, the radiologist deposits the

films in the proper permanent jacket, leaving the temporary work jacket empty and available for re-use. At frequent intervals (usually one to two hours), file-room personnel circulate through the various offices to pick up all permanent and empty temporary work jackets after interpretation has been completed. As the permanent jackets are returned to the file room, their respective x-ray numbers are erased from the tabulating board.

This tabulation and identification system, introduced only recently, has proved itself of great value. It is now possible to locate promptly all recently exposed and uninterpreted roentgenograms. In the past, our greatest difficulty lay in those situations where clinicians were anxious to see the roentgenograms in cases examined the day before or the same day. Frequently, a considerable period of time was required to locate such a case, often with a good deal of apprehension and anxiety on the part of the file-room clerk and ill feeling on the part of the clinician because of the excessive delay. A wait of more than a minute or two before a case is located is now exceptional.

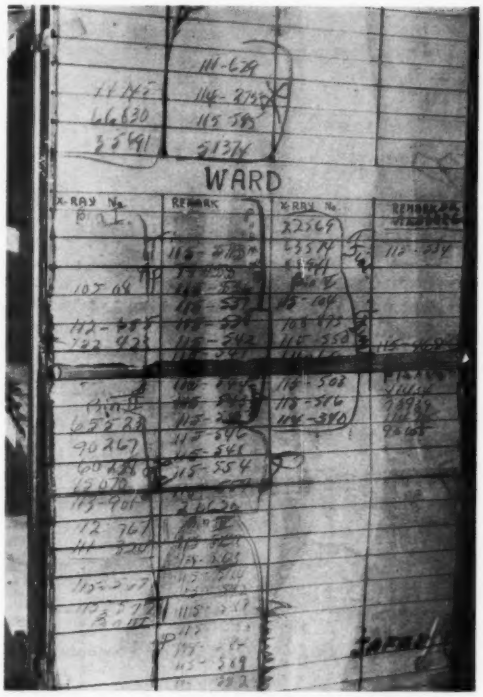

Fig. 4. Close-up view of the tabulating board. Groups of cases have been signed for by various radiologists. Interpretation has been completed on several cases and these numbers have been erased from the board.

SUMMARY AND CONCLUSIONS

We have presented a combination of vertical sorting and vertical distribution tabulating systems in the operation of the file-room in a busy x-ray department in a large general hospital. The combination of these systems has materially improved the service offered both for the clinicians and members of the radiology department desirous of viewing current and active cases undergoing roentgenographic examination and interpretation.

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REFERENCE

1. AMERICAN COLLEGE OF RADIOLOGY, COMMITTEE ON PLANNING OF RADIOLOGIC INSTALLATIONS: Planning Guide for Radiologic Installations. Chicago, Year Book Publishers, 1953, Chap. 13.

SUMMARIO IN INTERLINGUA

Organisation Del Archivos In Un Departimento De Radiologia

Es describite in detalio un systema archivari disveloppate pro accelerar le recovramento del roentgenogramma o roentgenogrammas demandate. A parte le costumari e permanente camisa pro le roentgenogrammas del casos individual in que le nomine del patiente, le numero de registration, e le typo e data de omne examine es listate, le systema usa temporari camisas "de labor" de varie colores que identifica le provenientia del material—patiente visitante, departimento hospitalari, neuroradiologia, fluoroscopia, etc.

Iste systema ha considerabilemente meliorate le servicio, tanto pro le clinico como etiam pro le membros del departimento de radiologia qui desira examinar le material pertinente a active e currente casos.

The Use of Automatic Computing Machines for Implant Dosimetry[1]

R. F. NELSON and M. L. MEURK

Generally the dose produced by implanting radioactive point sources within a patient is calculated by either the Paterson-Parker or the Quimby system. These systems assume a fixed distribution of sources, non-uniform and uniform respectively. Because of mechanical and physiological difficulties, however, these distributions are difficult to obtain.

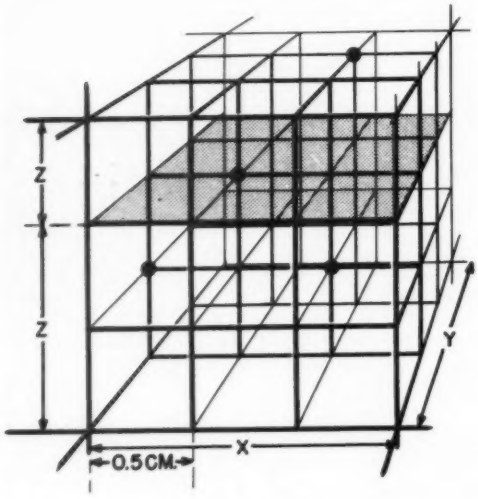

Fig. 1

The purpose of this paper is to present a method by which the dose distributions produced by any random arrangement of radioactive sources can be computed and tabulated automatically.

All possible positions of the sources are located in a three dimensional Cartesian co-ordinate system with interspaces of 0.5 cm. The X and Y co-ordinates of each source are expressed in terms of this lattice and this distribution may be extended for 11 cm. in each co-ordinate. The Z co-ordinate is distance from the plane under consideration (Fig. 1.).

The dose produced by each source is considered to be a function of the inverse-square law only. Such a dose is regarded as insignificantly small beyond 4.5 cm., as it is only 5 per cent of the dose at 1 cm. These data are tabulated and transferred to punch cards. The dose contributions at 0.5-cm. intervals in the X co-ordinate are tabulated on separate cards.

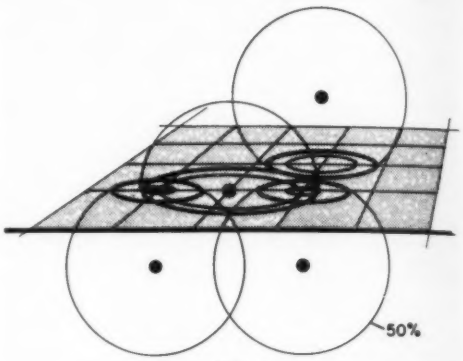

Fig. 2

Such cards are coded for each 0.5-cm. separation in the Y co-ordinate. Thus the data for the X-Y plane through the source is contained on 19 cards, referred to as a planar deck. The complete dose distribution throughout the volume of the sphere of influence of a source is given by 9 planar decks or a volume deck of 147 cards. There are volume decks $(19)^2$ to include all possible source locations. Each deck is coded with the X and Y co-ordinate of the sources. The Z co-ordinate varies for each planar deck.

The distribution of the implanted radioactive sources in the patient is determined by stereographic roentgenograms or by a tube-shift method. The sources are located in the Cartesian co-ordinate system to the nearest 2.5 mm.

The various planar decks are chosen for each source and are put in order by a sorting machine. The dose to any plane produced by radioactive sources within the implant is calculated by summing the dose from each source to that plane (Fig. 2).

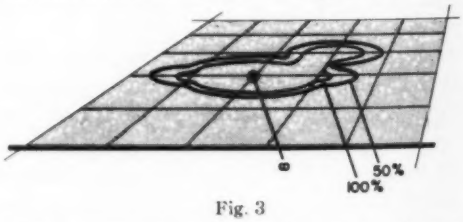

Fig. 3

The percentage dose rates are then automatically added, tabulated and printed for that particular plane by the accounting machine. The percentages are plotted on a Cartesian grid and the points of equal dose are joined, giving the dose distribution for a complete plane (Fig. 3).

[1] From the Department of Physics, Memorial Center, New York.

* The papers presented here were submitted for publication in October 1957 and were read at the Forty-third Annual Meeting of the Radiological Society of North America (Section C), Nov. 20, 1957.

Investigation of the X-Ray Emission Spectrum from Lesions and Tissue-Equivalent Sources Containing P^{32}[1]

K. E. CORRIGAN, Ph. D., and
H. HAYDEN CORRIGAN, Ph.D.

Many of the scintillation counters now in use in medical institutions will measure the soft x-rays emitted from P^{32} in a phantom or a patient. In general, this applies to scintillation counters built since the beginning of 1957 and a few of the older models. Many of the earlier ones, for various reasons, will not detect this radiation. This report deals with the determination of the exact nature of the bremsstrahlung spectrum from tissue and tissue-equivalent materials.

A suitable source of bremsstrahlen is easily prepared from a section of Lucite rod 25 mm. in diameter and 50 mm. in length. The rod is drilled axially with a 4-mm. drill to within 15 mm. of the end. A second piece of Lucite rod, about 8 mm. in diameter and 10 cm. in length, is selected. The 4-mm.-hole is counterbored to accept the second rod, to within 8 mm. of the end, leaving a 4×8 mm. cavity with a volume of approximately 0.2 c.c. P^{32} solution is inserted in the cavity, which must not be filled. A small segment of the 8-mm. rod is inserted and cemented to seal the cavity. The remainder of the 8-mm. rod is inserted and cemented to form a solid phantom and supply a stem for handling and mounting. The phantom will give an x-ray output of at least 300 c/m/μc as measured through the solid end, with a 1×1-inch sodium iodide crystal in a suitable scintillation counter. If the original charge is about 250 μc, the phantom will be useful for spectral determinations for several weeks and for localization practice and teaching for several months.

A single-channel analyzer mechanically coupled to a rectilinear recorder is used to obtain a graphic representation of the spectrum. To record the spectrum, the lead housing should be removed from the crystal, and all heavy metal from the immediate vicinity. The background count will be negligible with a window of 2 volts or less. With appropriate changes in the counting range, the entire spectrum can be recorded. It will be seen to begin at the theoretical upper limit and increase in quantity progressively as the base voltage is reduced. Only a negligible amount of radiation is obtained above 200 kev, but from this level the curve rises steeply to a maximum at approximately 22 kev, then falling off rapidly. The shape of the spectral distribution curve will change slightly with different crystals and different activations; however, there is no qualitative change in the record obtained from sodium iodide crystals 1×1 or 2×2 inches in size.

Of all the radiation appearing below 220 kev, about 24 per cent occurs above 88 kev, which is the critical absorption edge for lead. This energy makes possible a means for accurately calibrating the low end of the energy scale. If lead foil or tantalum foil is wrapped around the Lucite phantom, the Kα peak at 74 kv or 57 kv, respectively, will appear. The upper range is calibrated with Co^{60}, Cs^{137}, and I^{131}, in the usual manner.

The overall purpose of the study is to develop better counters for the localization of P^{32} in cases presenting diagnostic problems. The present counters, when mounted in a scintillation scanner, will give a good representation of a weak P^{32} concentration under a thick layer of Lucite or in the bone of a living patient.

[1] From the William Beaumont Hospital, Royal Oak, Mich., and Wayne State University, Detroit, Mich.

Spectral Distributions of 140-kvp X-Rays[1]

D. V. CORMACK, D. G. BURKE, and W. E. DAVITT

A scintillation spectrometer with a 2×2-inch sodium iodide crystal has been used to measure the primary spectral distribution of radiation from a Picker Vanguard machine operated at 140 kvp.

RELATIVE NUMBERS OF PHOTONS PER SQUARE CENTIMETER PER KEV

	Primary	Scattered
10	5	0
20	55	43
30	108	210
40	100	340
50	82	320
60	92	240
70	90	140
80	63	66
90	40	25
100	22	9
110	10	3
120	3	2
130	1	0

The measured spectrum was corrected for statistical spread of pulses in the photomultiplier and for escape of iodine K x-rays from the crystal. The corrected primary spectrum is given in the accompanying table. Diaphragms with very small apertures were required in order to reduce the counting rate in the photomultiplier sufficiently. It was found that the shape of the measured spectrum was critically dependent upon the alignment of the diaphragms and there was also some indication that the spectral distribution varied from one part of the x-ray target to another.

Measurements were also made of the spectral distributions of the scattered radiation traveling at various angles in a water phantom irradiated with 140-kvp x-rays. These distributions were then integrated over all angles to obtain the total number of photons at the various energies. The integrated scattered spectrum at a depth of 5 cm. and for a

field 300 cm.^{2} in area is shown in the table. The values have not been normalized to correspond with the primary values. Preliminary measurements with other depths and fields indicate that the spectral shape is rather insensitive to changes in these parameters.

[1] From the University of Saskatchewan and Saskatoon Cancer Clinic, Saskatoon, Sask.

Determination of the Absorbed Dose in Radiation Therapy[1]

J. ROBERT ANDREWS, M.D., D.Sc. (Med.), ROBERT W. SWAIN, B.S., HERMAN D. SUIT, M.D., and CHARLES R. MAXWELL, Ph.D.

The adoption of basic energy units for the expression of the absorbed dose of radiation (1) makes desirable a means for determining absorbed dose in rads under conditions simulating clinical radiation therapy and in actual clinical therapy. The ferrous sulfate dosimeter provides a means for determining absorbed dose under the first of these conditions (2).

The ferrous sulfate dosimeter has been used to determine the average absorbed dose (rads) both within and outside of the geometric beam of a 2-MEV Van de Graaff accelerator, using a multiple compartment Lucite tank. The volume of solution irradiated is known, and the integral absorbed dose (gram rads) is the product of the average absorbed dose and the mass irradiated. The tank is filled with the solution, and the geometric beam is directed into one of the tank compartments for the determination of the average absorbed dose within the beam. The remaining compartments, also filled with the solution, provide a scattering medium and permit the determination of the average absorbed dose outside of the beam. After mixing of the solutions in the individual compartments, samples are withdrawn and analyzed for determination of the absorbed dose. Values of average (rads) and integral absorbed (gram rads) doses for various depths of media were compared with calculated values as determined by Mayneord's method. For the preliminary experiments, the field size was 5 × 5 cm. at 100 cm. from the target, with a depth of solution of 20 cm. In the geometric beam, the ratio of the experimentally determined to calculated dose was 0.75. The percentage of the integral dose in the geometric beam to the integral dose in a 43.3 × 43.3-cm. tank filled to a depth of 20 cm. was 51 per cent.

These principles were adapted to the determination of absorbed dose in a Lucite head phantom constructed to permit the introduction of a container simulating a tumor. Both the container and the phantom were filled with the dosimeter solution and the tumor-simulating compartment was irradiated by rotation technic simulating clinical radiation therapy. The average absorbed dose within the simulated tumor volume and in the remainder of the head phantom was determined and the integral absorbed dose in each was computed.

For a simulated nasopharyngeal tumor (a cylinder 5 cm. in diameter and 5 cm. high) irradiated by rotation technic, through a 7 × 7-cm. field, at a target-to-axis distance of 125 cm., the average dose determined with the chemical system was within 5 per cent of the axis dose calculated by the M.I.T. method and by ionization measurements. The integral dose in the simulated tumor was 10 per cent of the total integral dose in the head.

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[1] From the Department of Health, Education and Welfare, Public Health Service, National Institutes of Health, National Cancer Institute, Radiation Branch, Bethesda, Md.

The Oxidation of Ferrous Sulfate with 200-Kv X-Rays, Cobalt-60 γ-Rays and 22 Mevp X-Rays[1]

W. K. SINCLAIR and R. J. SHALEK

For the ferrous-ferric dosimeter, numerous G values (that is, the number of molecules oxidized per 100 ev) have been reported in the literature. For cobalt-60 γ-radiation the generally accepted value for this radiation is 15.6 molecules/100 ev. Recent measurements with 16-MEV and 6-MEV electrons (1) yielded the same value to within the limits of experimental error. Some other measurements (2) indicate slightly lower values for 200-kv x-rays, and certainly, as the energy decreases further, the G value appears to drop; for example, with tritium beta particles at 5.5 kev average, the G value is 12.9 (3).

In the course of radiobiological experiments comparing the three radiations listed above, it became necessary to measure the dose by chemical means. A comparison was therefore made between the values of G for the Fricke dosimeter for each radiation. These values depend on our current estimates of absorbed dose from exposure dose measurements, which are based in turn on Victoreen chambers calibrated at the National Bureau of Standards for 200-kv x-rays and cobalt-60 γ-radiation and by intercomparison with Dr. J. S. Laughlin for 22-Mevp x-rays (4). The chemical comparison was made by using an arrangement in which six Teflon cups containing 2 ml. of the dosimeter (1 mM $FeSO_4$, 1 mM NaCl in 0.8 N H_2SO_4) could be irradiated uniformly and simultaneously with doses of 1,000 to 9,000

TABLE I: SUMMARY OF DENSITY VS. DOSE DETERMINATIONS (SINCLAIR AND SHALEK)

	Rads/r	1	2	3	Average G value derived from pooled data
		Density per Kilorad			
		4/13/57	7/13/57	8/17/57	Molecules Fe^{+++}/100 ev
X-ray 200 kv (effective h.v.l. 0.78 mm. Cu)	0.975	0.03262 ±0.00051	0.03311 ±0.00074	0.03306 ±0.00045	14.4
Cobalt 60	0.972	0.03530 ±0.00033	0.03616 ±0.00027	0.03549 ±0.00039	15.6
Betatron, 22 Mevp	0.92*	0.03305 2 points only	0.03598 ±0.00063	0.03562 ±0.00101	15.6

* Applying cobalt-60 correction factor to the Victoreen reading to yield "high-energy exposure" in r. See Sinclair *et al.* (4).

rads. For each of the three radiations the exposures took place at a depth in Mix D tissue-equivalent wax through two parallel opposing fields, in order to obtain a uniform dose distribution. Measurements, were made with a 250-r chamber placed at the center of the exposure volume and calibrated against a 25-r substandard with a constant amount of stem exposure.

A correction was made for the softening of the x-ray beam from its primary value (200 kv, 0.5 mm. Cu + 1 mm. Al, h.v.l. 1.4 mm. Cu, equivalent wave length 96.5 Kev) to an effective h.v.l. of 0.78 mm. Cu (equivalent wave length 75.2 Kev) for a depth of 5 cm. in Mix D wax. Further corrections were made for the difference between the absorption properties of Mix D wax and water and for the absorption of x-radiation in the dosimeter components as compared with water for a given exposure dose. The concentration of ferric ion was determined by direct absorption at 3040 A°; the molar extinction coefficient was measured with known concentrations of ferric ion to be 2,157 at 25°C. The results obtained for the three experiments are shown in Table I.

There is very good agreement between each of the three series, and the standard deviation due to the scatter of points is shown. The main errors are in the calibration of exposure dose and the estimate of absorbed dose. In view of the inaccuracies involved, the conclusion may be drawn from these measurements that the G values for cobalt 60 and for betatron 22-Mevp x-rays agree to within the limits of experimental error, but that the G value for 200-kv x-rays (0.78 mm. Cu) is about 8 per cent lower.

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[1] From the Physics Department, University of Texas, M. D. Anderson Hospital and Tumor Institute, Houston, Texas.

The Relevance of the Skeletal Burden of Thorotrast to the Problem of Chronic Toxicity of Bone Seekers in Man[1]

L. D. MARINELLI

In the presence of Thorotrast in the human body a fraction of the radium daughters produced *in vivo* by radioactive decay become available to the circulation and are therefore deposited in part in the skeleton.

If the assumption is made that the radium available to the circulation is retained according to the law $R(t) = Af(t)^{-b}$, it is possible to calculate the elimination of radium daughters from the body and the radioactivity ratio of radium to thorium *in vivo*, both as a function of time. From data available in the literature, one can calculate within certain limits what fraction, f, of the radium daughters produced become available to the general circulation. From this figure, it is then possible to calculate the skeletal burden by using the values of A and b obtained in humans injected with Ra^{226}.

These calculations imply that in an average Thorotrast patient (4 gm. of Th^{232} = 0.44 μc) the activity of the skeleton in curies is between a minimum of 1.8×10^{-9} $Ra^{226} + 1.8 \times 10^{-9}$ $Th^{228} + 1.9 \times 10^{-8}$ $Ra^{224} + 1.7 \times 10^{-8}$ Em (equil.) and a maximum of 1.8×10^{-9} $Ra^{226} + 5.5 \times 10^{-8}$ $Th^{228} + 3.7 \times 10^{-8}$ $Ra^{224} + 3.3 \times 10^{-8}$ Em (equil.).

In terms of Ra^{226} alpha ray energy equivalents (11 MEV/Ra^{226} disintegration), these limits become

40 and 100 per cent, respectively, of the recommended maximum permissible limit of 0.1 μg of Ra^{226}.

If these calculations are substantially correct, then this group of individuals should be regarded as an irreplaceable source of observational material suited to the long-term study of chronic toxicity of bone seekers in humans.

[1] From the Radiological Physics Division, Argonne National Laboratory, Lemont, Ill. Work performed under the auspices of the U. S. Atomic Energy Commission.

A Method for In Vitro Determination of Tissue Dose from Thorotrast[1]

R. J. SCHULZ

Patients who have received injections of Thorotrast for radiographic procedures are burdened with small quantities of radioactive material and will be exposed to a nearly constant amount of highly ionizing radiation for the remainder of their lives. Thorotrast is a contrast medium containing thorium dioxide and is rapidly taken up by the reticuloendothelial system, particularly the liver and spleen. A better correlation between absorbed dose and histological change may be obtained by a systematic study of patients who have received Thorotrast injections.

The thorium family is made up from Th^{232}, an alpha emitter with a half-life of 10^{10} years, and eleven daughter products which emit alpha, beta, and gamma rays of a variety of energies. The accompanying table lists these products, indicating the energies of their corpuscular emissions. At the bottom is given the summation of the energies carried by the alpha and beta particles which result from the complete decay of one Th-232 nucleus. A determination of the microcuries per gram of tissue would enable one to calculate the dose rate in rads and also, with only slight error, the accumulated dose from the time of injection.

A relatively simple technic was used by the author to determine the dose to liver and spleen of a patient who came to autopsy at the Jacobi Hospital nineteen years after receiving an injection of an unknown amount of Thorotrast.

A survey of the gamma rays emitted by the members of the thorium family shows that Ra^{224}, the fifth member of the series, produces a single photon, whose energy is approximately 0.25 MEV. There are no other gamma rays emitted by any other member of the series which have energies near 0.25 MEV and whose intensities are greater than 1 per cent of the Ra^{224} gamma ray. Therefore, with a gamma ray spectrometer focused at 0.25 MEV, the number of microcuries of Ra^{224} in a gross tissue section can be determined. This is not done on an absolute basis but by comparing the count rate at 0.25 MEV to that produced by the 0.364-MEV gamma rays from a known quantity of I^{131}. If the relative counting efficiency for detecting system is known for the 0.25-MEV and 0.364-MEV energy settings, then the microcuries of Ra^{224} is given by:

$$\mu c\ Ra^{224} = \frac{\mu c\ I^{131}}{c/s\ (0.364\ Mev)} \cdot \frac{c/s\ (0.25\ Mev)}{R.C.E.} \cdot 0.78$$

where the quantity 0.78 is the relative intensity of the I^{131} 0.364-MEV photon and R.C.E. is the relative counting efficiency, which was 4.0 for the equipment used by the author.

If radioactive equilibrium exists, then the number of microcuries of Ra^{224} is equal to the microcuries of Th^{232}. Using the figures in the Table for the energy emitted per complete disintegration of a Th^{232} nucleus, and correcting for that portion of the energy expended within the Thorotrast granule, we have determined the dose rates and cumulative doses for the above mentioned patient (see top of next page).

THE THORIUM FAMILY

Element	A-Z	Half-life	Alpha energy-MEV	Max. Beta energy-MEV
Thorium	232-90	1.4×10^{10}y	3.98	
Radium	228-88	6.7y		0.053
Actinium	228-89	6.1h		2.0-50%
				1.55-50%
Thorium	228-90	1.9y	5.42-72%	
			5.34-28%	
Radium	224-88	3.6d	5.6	
Emanation	220-86	54s	6.3	
Polonium	216-84	0.16s	6.8	
Lead	212-82	10.6h		0.331-88%
				0.569-12%
Bismuth	212-83	1h	6.1-33.7% ↓	2.25-66.3% ↓
Polonium	212-84	3×10^{-7}s	8.8 ↓	
Thallium	208-81	3m		1.79 ↓
Lead	208-82		↓	↓
Total energy			35.9 MEV	1.93 MEV

Tissue	μc/gram	Portion of alpha energy expended in tissue (1)	Rads per day	19 years dose (rads)
Liver	0.00044	56%	0.52	3,600
Outer spleen	0.0027	26%	1.6	11,000

REFERENCE

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[1] From the Department of Radiology, Albert Einstein College of Medicine, New York, N. Y.

Measurement of the Neutron Response of a Graphite-CO_2 Ionization Chamber[1]

J. A. SAYEG, P. S. HARRIS, and T. A. ALLISON[2]

In the determination of neutron and gamma tissue doses by the tissue-equivalent ionization chamber method (1), the neutron response of the gamma-measuring graphite-CO_2 ionization chamber has been calculated from first collision theory with the assumption that the response is mainly due to the CO_2 gas (2). Experiments have been conducted with monoenergetic neutrons from the Los Alamos Van de Graaff generator to determine this response as a function of neutron energy. The detectors employed were a Hurst proportional counter, a beryllium-shelled condenser-type tissue-equivalent ionization chamber, and a beryllium-shelled condenser-type graphite-CO_2 chamber (3). The neutron response, K, was calculated from the relation:

$$K = a - \frac{T - G}{N} \qquad (1)$$

where a is the efficiency of our tissue-equivalent chamber in measuring a neutron dose when the chamber is calibrated with hard x-rays or gamma rays, T is the dose in r/n/cm.^{2} (in terms of an x-ray calibration) measured by the tissue-equivalent ionization chamber, G is the dose in r/n/cm.^{2} (in terms of an x-ray calibration) measured by the graphite-CO_2 chamber, and N is the neutron dose in rads/n/cm.^{2} measured by the Hurst proportional counter and normalized to the tissue-equivalent chamber composition (10.5 per cent H, 3.8 per cent N, and 85.7 per cent carbon by weight). The results, to date, are summarized in Tables I, II, and III.

TABLE II: MEASUREMENTS WITH IONIZATION CHAMBERS

Energy	Number of determinations	Measured energy absorption (T-G) r/n/cm.^{2} × 10^{-9}
1	2	2.02
2	4	2.66
4	4	3.32

TABLE III: TABULATED K VALUES

First collision theory and standard tissue			Experimental	
Energy (MEV)	K_C r/rad$_T$	K_{CO_2} r/rad$_T$	Chamber composition r/rad$_{ch}$	Normalized value for standard tissue composition r/rad$_T$
1	0.135	0.216	0.054	0.053
2	0.158	0.097	0.085	0.094
4	0.235	0.153	0.172	0.193

It can be seen from Table III that the K values to be used for our combination of chambers more nearly approach the values for CO_2 as predicted from first collision theory and standard tissue (10 per cent H, 12 per cent C, 4 per cent N, 73 per cent O, and 1 per cent other elements by weight). However, we are not able to state at the present time whether this response is actually due to CO_2 or to a combination of C and CO_2 modified by a variation in W at these low energies. It is believed that the large discrepancy at 1 MEV is due to the larger W value for the heavy recoils. It is expected that these questions may be resolved by measurements at higher neutron energies. The experiments are now being extended to 6 and 8 MEV.

TABLE I: MEASUREMENTS WITH THE HURST PROPORTIONAL COUNTER

Energy (MEV)	Number of determinations	Measured energy absorption in ethylene (MEV/g/n/cm.^{2}).	Normalized to tissue-equivalent ionization chamber composition (rad/n/cm.^{2} × 10^{-9})
1	7	0.180	2.18
2	6	0.244	2.97
4	4	0.333	4.11
6	2	0.324	3.96
8	2	0.404	5.04

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[1] From the Health Research Group, Los Alamos Scientific Laboratory, University of California, Los Alamos, N. M.
[2] Summer graduate employee.

Relative Stopping Powers in Pure Gases[1]

NORMAN A. BAILY, Ph.D., and GEORGE C. BROWN, A.B.

In order to transpose ionization measurements made in a gas to energy absorbed in tissue, the behavior and appropriate values of the relative stopping powers are needed. Since it is agreed that dose should be measured in units of energy absorbed per gram of tissue, and the measurements of ionization currents have been developed to a high degree, an experimental determination of the relative stopping power is of value to radiological physicists.

The method utilized in this experiment makes use of the Bragg-Gray principle (1) and the conformance of the Failla (2) extrapolation chamber to this principle. The method is similar to that reported by Hersh (3). A radioactive isotope emitting only β rays is uniformly distributed in one of the chamber electrodes. In this experiment, S^{35}, Ca^{45}, P^{32}, and Y^{90} are under investigation. The results reported in this paper are those for S^{35}. The electrodes were so designed that, for the volume of interest, the energy emitted by the isotope and that absorbed by the materials, per unit mass, are the same.

The energy imparted to a material by ionizing particles (through ionization, atomic or molecular excitation and thermal agitation) may be determined by ionization measurements made in accordance with the Bragg-Gray principle.

The Failla extrapolation chamber was expressly devised to meet the requirements of the Bragg-Gray principle in the measurement of dose of ionizing radiation. If N_i is the number of ion pairs produced per second per gram of gas in the cavity, and W is the average energy lost by an electron per ion pair produced in this gas, the energy absorbed per gram of gas per second is N_iW.

The energy absorbed per second per gram of gas is related to the energy absorbed per second per gram of the solid material by a factor $\bar{S}$, which represents the average of the instantaneous relative mass stopping powers of the solid material with respect to the gas for all electrons in the energy spectrum existing in the material under equilibrium conditions. For the same radioactive electrode, but gases of different atomic number, the ratio of $W\bar{S}$ for each gas is then directly determined by the ratio of the ionization currents, since the conditions of the Bragg-Gray principle are fulfilled at all times. The introduction of different gases in the cavity does not in any way change the energy delivered to unit mass of the solid. Therefore, the ratio of the ionization currents is in reality the ratio of $W\bar{S}$ of the various gases measured.

The gases reported in this preliminary report are: air, hydrogen, helium, nitrogen, oxygen, neon, and xenon. In the cases of air, hydrogen and nitrogen, the gases were dried by circulation through P_2O_5. The purity of the hydrogen was 99.9997 per cent and that of the nitrogen was 99.98 per cent. All of the others were spectroscopically pure. The helium and neon gases were further purified by circulation through an activated coconut charcoal trap held at the temperature of liquid nitrogen.

The results for $\bar{S}$, shown in the accompanying table, were computed using values of W taken from the literature (4).

Gas	W	$\bar{S}\Big]^{\text{gas}}_{\text{air}}$ per gram	$\bar{S}\Big]^{\text{gas}}_{\text{air}}$ per electron
Air	34.1	1.00	1.00
H_2	36.8	2.60	1.31
He	42.3	1.74	1.74
N_2	34.8	1.01	1.01
O_2	31.2	0.989	0.989
Ne	36.7	1.24	1.25
A	26.4	0.760	0.843
Xe	22.1	0.624	0.758

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[1] From the Department of Radiation Therapy, Roswell Park Memorial Institute, Buffalo, N. Y. This investigation was supported in part by a research grant (C-2866) from the National Cancer Institute, U. S. Public Health Service.

Clinical Dosimetry

H. E. JOHNS,[1] G. D. ADAMS,[2] H. L. ANDREWS,[2] L. H. LANZL,[4] J. S. LAUGHLIN,[5] and W. K. SINCLAIR[6]

This year a Dosimetry Sub-Committee of the Radiation Study Section of the Division of Research Grants, National Institutes of Health, was formed to establish uniformity of radiation dosimetry for clinical studies. This committee has met twice to dis-

	Maximum variation	Mean variation
Cobalt 60	1.4%	1.2%
h.v.l. 2.0 mm. Cu	2.0%	0.9%
h.v.l. 1.2 mm. Cu	2.0%	0.4%
h.v.l. 0.5 mm. Cu	2.3%	1.2%
25 MEV x-rays*	2.0%	1.2%
25 MEV electrons*	2.0%	1.2%

* The values given in the table for 25-MEV x-rays and electrons were obtained using the cobalt 60 NBS or NRC calibration factors.

cuss dosimetry problems relating to the measurement of exposure dose over the energy range from 200 kv to 100 MEV. The committee met in New York in October and compared their pre calibrated dosimeters (consisting of 25-r Victoreen chambers) with 200 kv, with cobalt 60, with 25-MEV x-rays, and with 25 MEV electrons. The response on these chambers was corrected using the NBS or NRC calibration factors for 200-kv radiation and for cobalt 60. The mean and the maximum variation from the average are indicated in the accompanying table.

The results given in the table are for six different dosimeters from various parts of Canada and the United States, and the agreement is considered to be reasonably good. The committee hopes to have another comparison at a later time to establish the reproducibility of such measurements.

As well, the committee has considered practical methods for the determination of absorbed dose from exposure dose. The committee hopes to establish uniformity in all aspects of absorbed dose specification.

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EDITORIAL

On Making a Roentgen Diagnosis

Medicine's increasing dependence on the roentgenologist's opinion places upon him a heavy responsibility. As roentgenology continues to grow, this burden will also increase. Many conditions are treated chiefly upon the basis of the x-ray report, which is, of course, as it should be, since roentgenology competently practiced is a reliable, objective, and determinate medical specialty. We must continually ponder the implications of our words, therefore, and realize the possible significance of our opinions for the health and, indeed, the very life of the patient.

"I don't know" or "impossible to tell" are neglected statements in x-ray reporting; yet such opinions constitute a form of positive knowledge. This is so because they express either the individual's own limitations or those inherent in the specialty. These limitations the roentgenologist must strive to learn and he must always stay within them. To know that one doesn't or cannot know is concrete and necessary knowledge; but not to know that one doesn't know or to think that one knows when he really does not or cannot is a false and dangerous state. Limitations must be taught and learned in a direct and positive manner, just as the trainee, for instance, is made to grasp the roentgen signs of fracture. Few articles and texts deal adequately with this important aspect of roentgen diagnosis.

A roentgenologist may sometimes even deliberately guess or take a flyer in situations where the patient's health or future may be at stake. In any medical practice, however, where the potentiality for definitive results is high, and where at the same time a negative report may carry equal weight in the exclusion of disease, a thorough knowledge of all limitations must be made known to the clinician. Every physician is taught the limitations of the Wassermann test, the tuberculin test, auscultation of the lungs, and palpation of the abdomen, but how many have been instructed to stay within the known deficiencies of roentgenology in seeking to differentiate between peptic and cancerous ulcer in the stomach, or to tell whether a bone tumor is benign or malignant?

Let us take one concrete example from gastric roentgenology. In order to evaluate the attitudes and approach commonly in practice, three experienced roentgenologists were shown six proved malignant narrowings in the prepyloric region. These lesions had previously been selected because they were considered to present no roentgen findings upon which one could dependably base a diagnosis of cancer. Obviously, therefore, the correct "diagnosis" in each case would be "don't know, cannot be told." The examiners were instructed to report either benign, malignant or "don't know" as their experience dictated. Only one case was diagnosed as malignant by all three examiners, but none could later offer a reliable basis for this opinion related to generally recognizable facts or findings. In only a few of the total 18 opinions did the roentgenologists admit that they were incapable of making a specific diagnosis. Thus, many of the diagnoses given were benign stenosis, and no single examiner said "don't know" in more than two of the six cases.

We need to test ourselves more often in such fashion to set our minds straight and to clear them of the half truths, fancies, and false knowledge that radiology has carried along in its rapid growth and

expansion. One could, in fact, spend much of his time dispelling the erroneous conceptions that have been entwined in our thinking.

Diagnostic roentgenology is so vital and so important a part of medical practice in its own right that there is no need or excuse for us to try to extend ourselves beyond firm ground. To play a hunch or to deliberately guess in order to gain easy glory may serve to deny a patient recourse to some other means of diagnosis that might be reliable in the particular circumstance. Playing hunches can eventually undermine not only the individual roentgenologist's reputation but more significantly that of the specialty he represents.

When candidates are before the examining boards it would be well to determine how thoroughly each appreciates his own limitations as well as those inherent in diagnostic roentgenology. A sign of maturity is to know oneself and the tools with which one must work. Such insight is a requisite, as well, for the mature radiologist.

ROBERT S. SHERMAN, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

NINTH INTERNATIONAL CONGRESS OF RADIOLOGY

As previously announced, the Ninth International Congress of Radiology will be held in Munich, Germany, July 23 to 30, 1959, under the presidency of Professor Dr. B. Rajewsky of Frankfurt. As at previous congresses, an extensive technical exhibition will be held to give industrial firms both from home and overseas an opportunity to display their products. Firms which wish to participate are requested to write the Managing Chairman of the Exhibition, Herr Dr. H. Messinesis, Mönckebergstr. 7, Hamburg 1, Germany.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY

New officers of the Northern California Radiological Society are as follows: President, Warren A. Wass, M.D., Lodi; Secretary, LeRoy K. Mills, M.D., 3235 Fair Oaks Blvd., Carmichael, Calif.

TORONTO RADIOLOGICAL SOCIETY

At a recent meeting of the Toronto Radiological Society, Dr. R. B. Holmes was elected President, Dr. K. P. Bonner, Vice President, and Dr. L. R. Harnick, X-Ray Department, Toronto Western Hospital, 399 Bathurst St., Secretary-Treasurer.

EASTERN CONFERENCE OF RADIOLOGISTS

The Eastern Conference of Radiologists will be held in Philadelphia at the Bellevue-Stratford Hotel, March 6-8, 1958. All radiologists and their wives are most cordially invited to attend.

Registration will be on Thursday afternoon and evening, March 6. An excellent scientific and social program has been arranged. Complete information will reach each member by mail in January, 1958. The preliminary announcement has already been mailed.

Please address any communications to Nathan P. Salner, M.D., Secretary, 6812 Castor Avenue, Philadelphia 49, Penna.

MODIFICATION OF THE BASIS FOR ROENTGEN CALIBRATIONS, 0.5 TO 3 MEV

In a joint statement, the National Bureau of Standards in Washington, D. C., and the National Research Council of Canada have announced a change, to take effect Jan. 1, 1958, in the basis for instrument calibrations in roentgens in the energy region from 0.5 to 3 MEV. The change is due to a revised estimate, based on improved data, of the "stopping power" corrections that must be applied to the materials involved in the calibration procedure.

Affecting instruments that measure radiation exposure dose, the new calibration base results in a small change in the calibration factor for radiation in the indicated higher-energy range. Thus, to conform to the new basis, instruments calibrated in roentgens with cobalt-60 gamma rays prior to Jan. 1, 1958, should have their calibration factors reduced by 1.8 per cent; and those whose scales were calibrated prior to that date should have their scale readings changed in the same way, *i.e.*, multiplied by 0.982.

COURSE IN CLINICAL USE OF RADIOACTIVE ISOTOPES

A course in the clinical use of radioactive isotopes will be given under the supervision of Dr. Sergei Feitelberg and Dr. Edith Quimby, of the Department of Radiology, Columbia University, New York City, from June 2 through June 28, 1958. This is a full-time course which includes lectures, experimental laboratory exercises, clinical rounds, and clinical measurements on patients and on specimens. In addition to Professors Feitelberg and Quimby, the teaching staff includes sixteen invited lecturers from the New York area, each presenting material in his own special field.

Lectures. Topics include physics of radioactive isotopes, interaction of radiation and matter, and technics of measurement of radiation and of radioactive isotopes. Clinical uses of radioactive iodine, phosphorus, and gold will be presented in detail; special lectures will cover miscellaneous diagnostic studies with radioactive iron, sodium, chromium, and other elements. Organization of isotope work in a hospital will be developed from a practical point of view.

Laboratory Work. Thirteen afternoons are devoted to experiments on basic methods of radioisotope measurements, technics used in clinical studies, and experience with actual clinical procedures.

Enrollment in the class is limited to 20; the fee is $300.

Inquiries should be addressed to Dr. Sergei Feitelberg, Mt. Sinai Hospital, Fifth Avenue at 100th Street, New York, N. Y.

RADIOLOGIC PHYSICS COURSE COLUMBIA UNIVERSITY

The College of Physicians and Surgeons of Columbia University announces a course in radiologic physics leading to the degree of Master of

Science, to be given during the academic year 1958–59.

This is a full-time integrated course, including lectures, seminars, conferences, and laboratory work. The faculty are members of the Department of Radiology. Drs. Rossi, Quimby, Rugh, Braestrup, Feitelberg, and Gross will cover different phases of radiologic physics and radiobiology, while Drs. Seaman and Kligerman will present clinical applications. Practical laboratory work will be stressed, a large number of experiments being planned to cover all aspects of the course.

Prerequisite for admission is a bachelor's degree, with a major or very strong minor in physics, or equivalent scholastic background, with a good academic record. Tuition for the complete course is $900. The registration will be limited to 6.

Inquiries should be directed to Dr. Harald H. Rossi, 630 West 168th Street, New York 32, N. Y.

PHYSICS AND CLINICAL APPLICATIONS OF RADIOACTIVE ISOTOPES

The Postgraduate Division of the School of Medicine of the University of Southern California announces a postgraduate course in The Physics and Clinical Applications of Radioactive Isotopes. This course is under the direction of Henry L. Jaffe, M.D., Clinical Professor of Radiology (Therapeutic) of the Department of Radiology in the Cedars of Lebanon Hospital, and Herman R. Haymond, Ph.D., Associate Professor of Radiology (Physics) of the Department of Radiology in the Los Angeles County General Hospital. The course will be held at the Los Angeles County and Cedars of Lebanon Hospitals on Friday afternoons from 4 to 5 P.M., beginning Jan. 31, 1958. It is intended to provide practical material for physicians who desire to secure clinical training in this field, and for those who merely wish to know more about the possibilities of radioactive isotopes.

Further information may be obtained from the Director, Postgraduate Division, School of Medicine, University of Southern California, 2025 Zonal Avenue, Los Angeles 33, Calif.

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES

Applications are now being accepted by the Oak Ridge Institute of Nuclear Studies for participation in a two-week course in Industrial Isotope Radiography, to be held in Oak Ridge, Tennessee, May 5–16.

Conducted for the Atomic Energy Commission by the Special Training Division, the course is designed to assist supervisory and technical personnel in obtaining sufficient facility in the use of sealed isotope sources to employ them safely and efficiently. Deadline for application for participation in the course is March 15, 1958.

Brochures describing the course in detail and application blanks are available from Ralph T. Overman, chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117.

AMERICAN SOCIETY OF X-RAY TECHNICIANS

The American Society of X-Ray Technicians will hold its Thirtieth Annual Convention June 7–12, 1958, at the Adolphus Hotel, Dallas, Texas.

CLINICAL FELLOWSHIPS AMERICAN CANCER SOCIETY

The American Cancer Society has announced that Clinical Fellowships at the senior resident level for the academic year 1959-60 may be applied for by institutions accredited by the Council on Medical Education and Hospitals of the American Medical Association to give training in the following specialties and sub-specialties, with emphasis on the diagnosis and treatment of cancer: internal medicine, malignant diseases, neurological surgery, obstetrics and gynecology, orthopedic surgery, otolaryngology, pathology, public health, radiology, surgery, and urology. The annual stipend, tax exempt, is $3,600.

Application forms are available from the Director of Professional Education, American Cancer Society, Inc., 521 West 57th Street, New York 19, N. Y. Feb. 15, 1958 is the deadline for institutions submitting applications for the 1959–60 Clinical Fellowships.

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

A recent article by Atkins and Hodes (RADIOLOGY, September 1957) on the use of oral antihistamines in intravenous urography is further evidence to confirm that we have, as yet, no satisfactory physiological remedy for the minor but troublesome side-effects which so frequently accompany the injection of intravenous urographic media. However, there may be a fairly satisfactory psychological approach to this matter. Our experience along this line does not warrant a formal paper, but this letter is offered for what it may be worth.

Several years ago we had the fortunate experience of conducting an intravenous urographic study on an emotionally stable and extremely objective clergyman. He experienced more than his share of minor side-effects, including nausea, a generalized feeling of "burning up," a sense of dizziness amounting almost to syncope, and venospasm. There were no major side-reactions. In discussing his sensations afterward, the patient stated that the

reactions were not unbearable in themselves, but that he had become quite apprehensive because they were so unexpected. He suggested that some instruction to the patient as to what he might expect would take most of the "sting" out of these side-effects. We have since found such instruction quite effective and our patients seem to accept the side-effects as a matter of course. An elderly patient, who had previously had several intravenous pyelograms, volunteered the information that he relieved his sensations of nausea and flushing by breathing deeply and slowly. We were at a loss to explain this on a physiological basis, but we readily accepted this procedure as an added psychological maneuver. The conscious effort at slow and deep breathing gave the patient something to concentrate on and something to do until the symptoms subsided.

Our procedure is to make certain that the patient understands the nature and purpose of the examination before he is placed on the table. Then, just before the injection is made, we give him a "pep-talk" which goes about like this: "I want you to help me make this a good examination. I want you to tell me the very first moment you taste this stuff. It's going to taste a little salty. Also tell me, right away, just as soon as you feel warm or full about the face, or the neck, or anywhere else in your body. Your head may feel a little "woozy," or your stomach may growl a little. Be sure to tell me just when that happens."

As the injection is begun, we continue with our talk: "This may feel a little hot in the arm and shoulder, but that's O.K. It will pass." During the injection we keep up a constant patter of "Can you taste it?—Can you taste it now?" This fixes the patient's attention on the least of the side-effects.

When the patient tells us that he has any of the sensations we warned him about, we ask him to "breath deep and slow—deep and slow—deep and slow," actually timing the breathing for him.

We have not appreciably reduced the number of side-effects by this method. Suggestion may even have resulted in some increase in their percentage, but our patients are not the least concerned when they do occur.

We have no psychological remedy for major side-reactions such as asthma and urticaria. For these we still depend on the adrenalin syringe, readily at hand.

Very truly yours,
STANTON S. HOECHSTETTER, M.D.
Veterans Administration Hospital
Rutland Heights, Mass.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

NUCLEAR ENERGY IN THE SOUTH. Edited by REDDING S. SUGG, JR. A volume of 152 pages, with 11 figures and 11 tables. Published by Louisiana State University Press, Baton Rouge 3, La., 1957. Price $3.50.

L'INTESTIN GRÊLE NORMAL ET PATHOLOGIQUE (ÉTUDE CLINIQUE ET RADIOLOGIQUE). By E. CHÉRIGIÉ, P. HILLEMAND, CH. PROUX, AND R. BOURDON. A volume of 578 pages, with 556 figures. Published by Expansion Scientifique Française, 15 Rue St.-Benoit, Paris 6e, France, 1957.

L'ARTHROGRAPHIE OPAQUE DU GENOU: CONTRIBUTION AU DIAGNOSTIC DES DÉRANGEMENTS INTERNES DU GENOU. By PAUL FICAT, Assistant de Chirurgie des Hôpitaux, Diplôme d'Électro-Radiologie. Preface by Pr R. Merle D'Aubigné. A volume of 244 pages, with 139 figures. Published by Masson & Cie, Libraires de L'Académie de Médecine, 120 Boulevard Saint-Germain, Paris 6e, France, 1957. Price 3,800 francs.

PHYSIKALISCHE GRUNDLAGEN DER RÖNTGENDIAGNOSTIK. By DR. PHIL. G. SPIEGLER, F. Inst. P., F. R. P. S., London, England. With a Foreword by Prof. Dr. H. R. Schinz, Zürich. A volume of 94 pages, with 71 figures. Published by Georg Thieme Verlag, Herdweg 63, Stuttgart 14a, Germany, 1957. Distributed in United States and Canada by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 18.—($4.30).

NIERENKRANKHEITEN: PHYSIOLOGIE, PATHOPHYSIOLOGIE, KLINIK UND THERAPIE. By HANS SARRE, Dr. Med. o.ö. Professor der Inneren Medizin, Direktor der Medizinischen Universitäts-Poliklinik, Freiburg i. Br., Germany. A volume of 540 pages, with 118 figures. Published by Georg Thieme Verlag, Herdweg 63, Stuttgart 14a, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 59.—($14.05).

ANGIOGRAPHIE DER NIEREN. By ERICH VOGLER, Univ.-Dozent Dr. Med. Univ. (Zentral-Röntgen- und Radiuminstitut des Landeskrankenhauses Graz), and RUDOLF HERBST, a.o. Univ.-Prof. Dr. Med. Univ. (Vorstand der Urologischen Abteilung des Landeskrankenhauses Graz). With a Foreword by Hofrat Univ.-Prof. Dr. Med. Univ. Anton Leb, Graz. Fortschr. a.d. Geb. d. Röntgenstrahlen, Ergängszungsband 81. A volume of 112 pages with 182 figures, including

141 roentgenograms. Published by Georg Thieme Verlag, Herdweg 63, Stuttgart 14a, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 54.—($12.85).

Book Reviews

MAGNETIC REMOVAL OF FOREIGN BODIES. THE USE OF THE ALNICO MAGNET IN THE RECOVERY OF FOREIGN BODIES FROM THE AIR PASSAGES, THE ESOPHAGUS, STOMACH AND DUODENUM. By MURDOCK EQUEN, M.D., F.A.C.S., Recipient of the Thomas A. Edison Foundation Gold Award for Achievement and Contribution to the Arts and Sciences, 1944. Member of: American Laryngological Association, American Broncho-Esophagological Association, American Laryngological, Rhinological and Otological Society, American Academy of Ophthalmology and Oto-laryngology, Fulton County Medical Society, Southern Medical Association, American Medical Association, Fellow of the Southeastern Surgical Congress. Diplomate of the American Board of Otolaryngology. Founder and Chief of Staff of Ponce de Leon Infirmary. A volume of 94 pages, with 119 illustrations. Published by Charles C Thomas, Springfield, Ill., 1957. Price $4.50.

The author discusses the use of the semipermanent magnet in removing metallic foreign bodies from the air passages and the upper digestive tract. The specialized apparatus is also described. The role of fluoroscopy and radiography in locating the foreign body and making contact with it is detailed in numerous case reports.

This short monograph will be of chief interest to bronchoscopists, otolaryngologists, and thoracic surgeons. It is well illustrated with many roentgenograms of the reported cases.

IN MEMORIAM

ISADORE SIMON TROSTLER

1869-1957

Doctor Isadore Simon Trostler, a pioneer in radiology, passed away March 10, 1957, at Masonic Home, Sullivan, Ill.

Doctor Trostler was born in 1869, in Omaha, Nebraska, the eldest of seven children. His father, a Civil War Veteran, and his mother, a schoolteacher, saw to it that he received a public school education, and for this he always expressed his gratitude. As a lad he became interested in ornithology and herpetology, sending accounts of his observations and explorations to natural history magazines for publication up to the late 90's.

At eighteen years of age he was working as a court reporter and attending night school, when he was found to have active tuberculosis. Influential friends obtained for him an opportunity to live on

the Cody (Buffalo Bill) Horse Ranch at North Platte, Nebraska, and the eighteen months spent there not only restored his health but offered added opportunity for his hobby of nature photography. Returning to Omaha, he obtained employment in a drugstore to provide further means for his premedical education. There he became associated with a doctor who had recently graduated from the University of Würzburg, Germany, where he had attended lectures by Professor W. C. Roentgen. Naturally, this Omaha physician undertook to produce x-rays as an aid to his practice (1898) and found in his young associate an able assistant because of his photographic experience.

Doctor Trostler next became a technician in association with chemical investigations for food contamination conducted by the Department of Health. The money thus earned was devoted to his medical education. and in 1904 he was graduated from the Omaha Medical College, now the School of Medicine of the University of Nebraska. He at first took over the practice of a local physician at Niobrara, Nebraska. Later, following a six-month study trip in Europe, he located at Orleans, Nebraska, where he met and married Miss Rupelle Luce of Maine, then Principal of the Bellwood, Massachusetts, Public Schools.

While successful in general practice at Orleans, Doctor Trostler's desire to move to a larger medical center led him to Chicago. Buying the practice of Doctor William G. Butterman (1907), he was given membership on St. Joseph's Hospital Medical Staff. Because of his previous experience with x-rays, he was soon appointed radiologist and St. Joseph's Hospital became one of the few hospitals in Chicago to have x-ray work available for the staff. In addition he maintained a private practice and an x-ray laboratory. In 1920 he concentrated entirely on radiology at his office in the Marshall Field Annex Building.

Doctor Trostler was an early member of the Chicago Roentgen Society (1913), serving later as its President. He became a Fellow Emeritus in 1948 and in 1955 received a Citation Award and Scroll for his contributions to medical science through radiology.

Doctor Trostler was one of a small group who promoted the issuance of an invitation to mid-Western radiologists to meet at the Sherman Hotel in Chicago 1915, when the Central Radiological Society was organized, later to become the Western Roentgen Society, and eventually the Radiological Society of North America (1919). For his efforts as manager of the commercial exhibits and transportation through many years, the Executive Committee of the Society awarded him a gold medal.

As Chairman of the Medico-legal Committee of the Radiological Society of North America, Dr. Trostler wrote numerous articles along these lines and appeared in court as expert witness in many malpractice suits against physicians from Minnesota to Texas, from Pennsylvania to the State of Washington. His wide range of medical knowledge (more than 200 contributions to the literature) was recognized by a fellowship in the American College of Physicians.

Outside of the radiological field, he was permanent secretary of his medical class, a member of Alpha Mu Pi Omega Fraternity, a member of Modern Woodmen of America (1905) and, as a Mason, active in both the York and the Scottish Rite and in the Shrine throughout his life.

Service and friendliness were strong attributes, characterizing Dr. Trostler's activities in radiological affairs. He did not seek high office, but cheerfully and unsparingly gave of his time and ability to local and national medical bodies. Contributions and discussions on scientific programs were tempered by his wide knowledge of clinical medicine and emphasis upon the practical rather than book wisdom.

In his later years, depressed in spirit by the loss of his companion and weakened physically by conditions requiring repeated surgical procedures, he spent many lonely months in convalescent homes, so that the end was not unwelcome.

"Tros" gained the respect of all who knew him and was truly beloved by his associates.

BENJAMIN H. ORNDOFF, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Theodore R. Miller, M.D., 139 E. 36th St., New York 16, N. Y.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, C. Allen Good, M.D., Rochester, Minn.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, Paul Riemenschneider, M.D., Department of Radiology, Medical College, State University of New York, Syracuse, N. Y.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, T. Leucutia, M.D., 10 Peterboro, Detroit 1, Mich.

SOCIETY OF NUCLEAR MEDICINE. *Secretary*, Robert W. Lackey, M.D., 452 Metropolitan Bldg., Denver 2, Colo.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 1313 N. Second St., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Nathan M. Spishakoff, M.D., 405 N. Bedford Drive, Beverly Hills.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Putnam C. Kennedy, M.D., 540 N. Central Ave., Glendale 3. Meets second Wednesday, September, November, March, April, and June, Los Angeles County Medical Association Building.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, LeRoy K. Mills, M.D., 3235 Fair Oaks Blvd., Carmichael. Meets last Monday of every other month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Harold P. Tompkins, M.D., 658 S. Westlake, Los Angeles 57.

REDWOOD EMPIRE RADIOLOGICAL SOCIETY. *Secretary* Lee E. Titus, M.D., 164 W. Napa Street, Sonoma Calif. Meets second Monday every other month

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Stanley A. Moore, M.D., 2466 First Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irma Smith, M.D., 450 Sutter St., San Francisco 8. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Howard L. Jones, M.D., Palo Alto Hospital, Palo Alto. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, John H. Heald, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:30 P.M., Children's Hospital, September through June.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Lorenz R. Wurtzebach, M.D., 601 E. Nineteenth Ave., Denver 5. Meets monthly, third Friday, at Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary-Treasurer*, Charles E. Bickham, Jr., M.D., 1835 Eye St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Robert DeArmas, M.D., 135 Broadway, Daytona Beach. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, George P. Daurelle, M.D., Jackson Memorial Hospital, Miami 36. Meets monthly, third Wednesday, 8:00 P.M., at Mercy Hospital.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Luther Clements, Jr., M.D., 35 Linden Ave., N.E., Atlanta 8. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg.,

Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, Jun-chu'an Wang, M.D., The Queen's Hospital, Honolulu 9. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, Arthur S. J. Petersen, M.D., 11406 S. Parnell Ave., Chicago 28. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, William Meszaros, M.D., 1825 W. Harrison St., Chicago.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, James R. Stark, M.D., 3244 East Douglas St., Wichita. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert H. Akers, M.D., 1405 West Broadway, Louisville 3. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, Seymour Ochsner, M.D., Ochsner Clinic, New Orleans 15.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Francis J. O'Connor, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, James K. V. Willson, M.D., 1100 N. Charles St., Baltimore 1. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, Dr. Joseph O. Reed, Jr., 3825 Brush St., Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets three times a year, in Fall, Winter, and Spring.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert P. Henderson, M.D., 316 Medical Arts Bldg., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, Lewis Allen, M.D., 907 N. 7th St., Kansas City 1, Kans. Meets last Friday of each month.

GREATER ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Thomas F. Maher, M.D., 634 N. Grand Blvd., St. Louis, Mo. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur T. Austin, M.D., 104 The Doctors Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGIC SOCIETY. *Secretary-Treasurer*, Paul J. Kingston, M.D., 114 Woodland St., Hartford, Conn. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, John E. Gary, M.D., 1180 Beacon St., Brookline 46, Mass. Meets monthly on third Friday, October through May, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnson, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Dr. Andrew P. Dedick, Jr., M.D., 67 E. Front St., Red Bank. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Solomon Schwartz, M.D., 555 Prospect Place, Brooklyn 38. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary*, Charles Bernstein, M.D., 685 Delaware Ave., Buffalo 9. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary-Treasurer*, Wilbur S. Brooks, M.D., 116 East Castle St., Syracuse 5. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ernest I. Melton, M.D., 2187 Ocean Ave., Brooklyn. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold G. Jacobson, M.D., Montefiore Hospital, 210th St. and Bainbridge Ave., New York 67, N. Y.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF STATE OF NEW YORK. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, John W. Colgan, M.D., 277 Alexander St., Rochester 18. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston Post Road, Port Chester. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary*, Francis C. Curtzwiler, M.D., 421 Michigan St., Toledo 2.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederick A. Rose, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March and April, at Tudor Arms Hotel.

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Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Meets annually.

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ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 20, Colo.

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SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wayne Reeser, M.D., 1600 Ninth Ave., Conway. Meets with State Medical Association in May.

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LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Louis Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

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SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Heart and Blood Vessels

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Observations on Cranial Radiography in a Series of Intracranial Tumours. Trevor Griffiths. Brit. J. Radiol. **30**: 57–69, February 1957. (South East Metropolitan Regional Neurosurgical Centre, The Brook Hospital, Shooters Hill Road, London, S. E. 18, England)

Plain films of the skull from 625 cases of verified intracranial tumor have been reviewed by the author. The study of such films continues to form an indispensable preliminary to any further radiological examination which may be necessary. Some of the abnormalities seen are considered at length, their incidence assessed and compared with that noted in other series of cases. Attention is called to the classification of gliomas devised by Kernohan and Sayre (Atlas of Tumor Pathology, Sec. X, Fasc. 35 and 37, Armed Forces Institute of Pathology, Washington, D. C., 1952), which has received wide clinical acceptance.

Four tables are presented. These show the types of intracranial tumor which may be encountered; the incidence of different types as reported by various authorities and in the author's own series; the help which was obtained from the plain films in the various tumor groups, *i.e.*, the incidence in which it was possible to deduce the presence of a tumor or of raised intracranial pressure, which generally indicates the presence of a tumor.

Among the 625 cases reviewed, the plain films of the skull pointed definitely to an intracranial tumor or to raised intracranial pressure in 282; in a further 87 cases the evidence was strong but not definite. Thus in 45 per cent of the cases the evidence was definite, and in a further 14 per cent highly suggestive.

Thirteen roentgenograms; 5 drawings; 4 tables.

FRANK L. LESKO, M.D.
Indiana University Medical Center

Management of Intracranial Bleeding. Maurice L. Silver. J.A.M.A. **163**: 1097–1102, March 30, 1957. (102 Waterman St., Providence 6, R. I.)

From an analysis of 100 personal cases of intracranial bleeding, the author urges a dynamic diagnostic and therapeutic approach to this problem. He considers the use of cerebral angiography an essential diagnostic procedure even if the patient is in poor condition. No intelligent treatment can be undertaken without the specific information supplied by this means. The author has himself performed 800 cerebral angiographic examinations without morbidity attributable to the procedure itself, which is evidence in favor of its safety and reliability.

Of the 100 cases analyzed, 55 were due to saccular aneurysms of the circle of Willis or of the major branches of the internal carotid artery. Of this group of patients, 49 had solitary aneurysms as determined by bilateral carotid angiography (vertebral angiography was performed in only 22 cases) while 6 had multiple aneurysms. Ten patients had arteriovenous aneurysms or cerebral angiomas, and 4 had cerebral tumors. Thus, 69 patients were found to have a vascular malformation by angiography. In 20 of the remaining 31 patients intracerebral hematomas were found, and in 16 of these the presence of a hematoma could be diagnosed from the angiogram. In 4 patients, ventriculography was performed in the presence of a presumably negative angiogram, and an intracerebral hematoma was localized. In the remaining 11 patients, trauma was considered unlikely and no vascular malformation, tumor, or intracerebral hematoma was visualized, regardless of the diagnostic technic employed.

In this series cerebral angiography yielded a positive diagnosis as to cause, or at least as to associated manifestations of intracranial hemorrhage, in 85 per cent of the cases. It is stressed that vertebral angiography should be carried out if bilateral carotid angiography reveals no positive findings.

Aneurysms of the anterior cerebral artery near the anterior communicating artery may give confusing localizing signs since an aneurysm on one side of the midline may rupture toward the opposite cerebral hemisphere, the symptoms then being those of interruption of the fiber pathways from that side. Generally, convulsions are rare with saccular aneurysms and frequent with arteriovenous aneurysms. Likewise, neurological deficit prior to rupture is rare with saccular aneurysm, except for cranial nerve palsy, whereas neurologic deficit may exist prior to rupture with arteriovenous aneurysms.

The author urges surgical treatment for demonstrated single aneurysms and is satisfied with so-called conservative therapy only when no lesion can be discovered by angiography and when multiple aneurysms are present. Aneurysms of the middle cerebral artery are particularly treacherous, since occlusion of this vessel may result in hemiplegia with aphasia. In patients with an intracerebral hematoma, the source of bleeding may be hidden by the pathological changes about the hematoma. The prognosis for the patients who have intracranial bleeding without a demonstrable lesion is very satisfactory.

The author concludes that all patients suffering intracranial bleeding should be subjected to prompt cerebral angiography to determine the pathologic nature of the lesion. This examination should be carried out as soon as possible after the episode of bleeding, and treatment for the lesion should be instituted as soon as practical. Surgical removal of an intracranial hematoma, reduction of arterial pressure to a weakened arterial wall (as by carotid ligation), or obliteration of a vascular malformation by clipping or coagulation may save a patient's life and eliminate the risk of subsequent rupture.

Twelve roentgenograms; 2 photographs.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Spontaneous Subarachnoid Hemorrhage. Clinical and Therapeutic Factors Affecting Prognosis. Joseph F. Rowley, James F. Sullivan, and Louis L. Tureen. Neurology **7**: 86–96, February 1957. (L. L. T., 457 N. Kingshighway Blvd., St. Louis 8, Mo.)

One hundred and fifty-seven cases of spontaneous subarachnoid hemorrhage from the neurological services of St. Louis City Hospital and the St. Louis University Hospital group were reviewed. These cases were collected from admissions during the years between 1945 and 1955, and are thought to represent only a portion of the patients suffering from spontaneous subarachnoid hemorrhage. The group included 29

patients in whom the diagnosis of subarachnoid hemorrhage was confirmed at autopsy; 16 with a history of subarachnoid hemorrhage, in whom a diagnosis of cerebral aneurysm was established by angiography; and 112 patients with classical symptoms of subarachnoid hemorrhage (sudden onset of headache, coma, or confusion followed by nuchal rigidity, with transient or no localizing neurologic signs, and bloody and/or xanthochromic spinal fluid at the time of examination).

The overall mortality rate for the 157 patients was 47.2 per cent, with the rate for males 52.2 per cent and for females 40 per cent. Fifty-five patients died during the first week of hemorrhage and 10 during the second week.

Angiography was performed on 30 patients, and aneurysms were detected in 13, multiple aneurysms in 1, and arteriovenous malformations in 3. Normal arterial patterns were demonstrated in 12. Results were unsatisfactory in 2.

Analysis of these few cases indicates that carotid artery angiography in the convalescent phase is a safe procedure as to immediate mortality, that it seems to be effective in preventing early rebleeding, and that neurologic sequelae to common carotid ligation are minimal under these conditions. In view of the high mortality rate during the first week, it is recommended that angiography be carried out within forty-eight hours of the onset of the hemorrhage, to be followed by common carotid artery ligation when the aneurysm is located.

Six graphs; 6 tables.

Agenesis of the Corpus Callosum. Report of Eight Cases in Infancy. Fremont P. Koch and Patrick J. Doyle. J. Pediat. **50:** 345–351, March 1957. (Childrens Hospital, Los Angeles 27, Calif.)

Eight cases of agenesis of the corpus callosum were observed at the Childrens Hospital, Los Angeles, between 1943 and 1956. The authors agree with previous observers that there is no definite clinical syndrome in this condition. Mental retardation was definite in 5 infants and was suspected in the other 3. Three infants had generalized convulsions and 1 of these later had episodes of focal seizures. Four had definite evidence of cerebral palsy: 2 spastic, 1 athetoid, and 1 flaccid. In addition, in 1 infant, there was questionable generalized muscle weakness. Associated abnormalities in the present series were cleft lip, cleft palate, corneal opacities, and hemangiomas. Enlargement of the head has been reported previously but not stressed as a significant finding; in 5 of the authors' cases it was the presenting symptom.

In 2 cases the diagnosis of agenesis of the corpus callosum was confirmed at autopsy, and in 1 case the defect was visualized at operation. The other 5 cases had the classical pneumoencephalographic criteria laid down by Davidoff and Dyke (Am. J. Roentgenol. **32:** 1, 1934): (1) marked separation of the lateral ventricles; (2) angular dorsal margins of lateral ventricles; (3) concave mesial borders of lateral ventricles; (4) dilatation of caudal portions of lateral ventricles; (5) elongation of interventricular foramina; (6) dorsal extension and dilatation of the third ventricle; (6) radial arrangement of the mesial cerebral sulci around the roof of the third ventricle and their extension through the zone usually occupied by the corpus callosum.

Six roentgenograms; 1 photograph; 1 table.

Cysticercosis Cerebri: A Diagnostic and Therapeutic Problem of Increasing Importance. James C. White, William H. Sweet, and Edward P. Richardson, Jr. New England J. Med. **256:** 479–486, March 14, 1957. (J. C. W., Massachusetts General Hospital, Boston 14, Mass.)

The recent literature on infection of the human brain by the larval form of *Taenia solium* indicates that this condition is becoming a neurosurgical problem of increasing importance. This is true not only in countries with poor hygiene but also in America and England. The authors report the diagnosis of cysticercosis cerebri in 3 patients seen in the Massachusetts General Hospital since 1952.

The first 2 cases represented solitary cysts, which resemble brain tumor in the production of localizing symptoms and signs. Ventriculograms showed a moderate degree of hydrocephalus in both instances, and a filling defect within the fourth ventricle could be identified in the first case. In each of these cases obstructive hydrocephalus was erroneously attributed to a midline tumor in the posterior fossa.

Relief was obtained by removal of the obstructing cysts from the fourth ventricle. In the second case, recurrent adhesions blocking the outflow of cerebrospinal fluid necessitated further surgery to re-establish ventricular drainage.

The third patient, a 36-year-old Venezuelan, suffered from epileptic seizures, and radiographs of the skull showed the presence of several irregular calcific densities scattered throughout the substance of the brain. These lesions were consistent with calcium deposits in the walls of encysted parasites. This combination is felt to be sufficient for the presumptive diagnosis of cysticercosis; this cannot be regarded as certain, however, even though no other parasite is likely to produce multiple calcified cysts of this size in the human brain. Other possible findings which may be indicative of the presence of cysticerci, such as eosinophilia and the occurrence of calcified cysts in the muscles, were lacking in this case.

Two other varieties of intracranial cysticercosis have been described. The first with multiple intracerebral cysts often leads to fatal edema of the brain, and the second to serious hydrocephalus from the presence of racemose cysts blocking the basilar and ambient cisterns.

Seven figures, including 1 roentgenogram.

ALVIN S. SEGEL, M.D.
Cleveland City Hospital

Cysticercosis of the Posterior Fossa. Edwin R. Bickerstaff, J. M. Small, and A. L. Woolf. Brain **79:** 622–634, 1956. (Midland Centre for Neurosurgery, Smethwick, Birmingham, England)

To understand the mechanism of production of symptoms in cysticercosis of the posterior fossa, it is necessary to appreciate that, while the cysticercus which develops in the hemispheres forms a small, fixed, firmly encapsulated cyst, those which develop in the cerebrospinal fluid pathways may differ both morphologically and in behavior. Several pathological forms are encountered: (1) the single cyst, similar in every way to those seen in the hemispheres but lacking at first the host capsule and therefore mobile, lying either in the third ventricle, aqueduct or fourth ventricle; (2) the racemose cyst, a large delicate, thin-walled, translucent, ramifying body, usually sterile, lying in the ventricular

system, the cisterna magna, or the cerebellopontine angle, and even extending through the foramen magnum into the upper cervical region; (3) a basal arachnoiditis, without any obvious cysticercus in immediate relationship. Five cases are reported in clinical and pathological detail to illustrate each of these features, and to show how different varieties may occur in the same patient.

The clinical picture of posterior fossa cysticercosis differs strikingly from that in the classical syndrome of cerebral cysticercosis, and most cases present as posterior fossa or intraventricular tumors. The approach to correct diagnosis is discussed, and the importance is stressed of associating attacks of intermittent obstructive hydrocephalus and intermittent disequilibrium, occurring over several years, with characteristic cerebrospinal fluid changes and the opportunity of infestation. Electroencephalography is of value only if it shows a cortical focal discharge in a patient who has otherwise a purely posterior fossa syndrome. Roentgenograms of the skull rarely reveal calcified cysts, and it is important to examine the thighs, pelvis, and chest wall. In none of the authors' cases was there a marked eosinophilia until after surgical exploration. Ventriculography with air or Myodil gave the most information; not only did it disclose the site of the lesion but it gave a good indication of its nature. In 1 case the cysticercus was demonstrated just rostral to the fourth ventricle; in another a rounded defect was seen within the fourth ventricle, and the distribution of the Myodil in the cisterna magna suggested that it lay in the interstices of a multilocular body such as the racemose form; in 2 cases there was clearly defined obstruction to the roof foramina, such as might be caused by arachnoiditis. All showed generalized hydrocephalus.

Theories of the origin of the racemose cysticercus are discussed. It is suggested that the large growth of the structure results from the absence in the cerebrospinal fluid pathways of a limiting host capsule, and its shape is influenced by the direction of the cerebrospinal fluid flow.

Three roentgenograms; 5 photographs; 6 photomicrographs.

Aneurysms Arising at the Internal Carotid-Posterior Communicating Artery Junction. Phillip Harris and George B. Udvarhelyi. J. Neurosurg. **14:** 180–191, March 1957. (Royal Infirmary, Edinburgh, Scotland)

Of a series of 326 intracranial aneurysms, 90 arose at the junction of the internal carotid and posterior communicating arteries. Angiography is necessary for the diagnosis of these aneurysms, for the discovery of associated aneurysms, and for the demonstration of the adequacy of the collateral circulation. It is recommended that this procedure be carried out as soon as possible after the onset of symptoms. This is true especially in view of the fact that 75 patients experienced subarachnoid hemorrhage and that in 34 this was recurrent, usually at about the tenth day. The authors have chosen to obtain all of the cerebral arteriograms under general intratracheal anesthesia.

The aneurysms were found to vary widely in size—from 1.5 × 1.5 mm. to 29 x 15 mm. There was also a variety of shapes—globular, elongated, boot-shaped, and multiple lobular. In some instances, the irregular shape and density suggested partial thrombosis. Almost without exception, the aneurysms were seen to be directed backward, downward, and laterally. The thickness of the "neck" varied from 1.0 to 7 mm., with an average of 2.7 mm.

Treatment is discussed in detail.

Six roentgenograms; 4 photographs; 1 chart; 2 tables. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Cerebral Vasomotor Tone and EEG During Injections of Umbradil. An Experimental Study with a New Method. David H. Ingvar and Ulf Söderberg. Acta radiol. **47:** 185–191, March 1957. (Nobel Institute for Neurophysiology, Karolinska Institutet, Stockholm, Sweden)

This is a report of an experimental study using a new effective continuous method for measurement of the cerebral blood flow together with registration of the electroencephalogram and the systemic blood pressure as well as other variables. Previously, experimental studies of the cerebral circulation during injections of radiopaque agents have been made mostly by direct observation of pial vessels on the exposed brain surface. Such methods are limited to surface vessels and lack sufficient sensitivity to determine small caliber changes. In this study the cerebral blood flow was measured following the injection of Umbradil in varying concentrations *via* the carotid artery or femoral vein of anesthetized or unanesthetized cats. Most intracarotid injections were made with doses in proportion to body weight, roughly corresponding to the single dose used routinely in clinical cerebral arteriography.

The method of studying the cerebral blood flow involved the measurement of a total venous outflow from the cannulated sagittal sinus after the anastomosis to the diploic veins had been eliminated. An electric drop recorder was used for measuring the flow from the cannula. In most instances craniotomy over the sagittal sinus was closed by dental acrylate resin in order to restore intracranial pressure conditions. The blood pressure was measured in the femoral artery with an electromanometer. In some experiments the ear skin temperature was followed as an index of cutaneous circulatory conditions.

Electroencephalographic recordings taken continuously during the injections did not show any changes of a local or general character after intracarotid administration of small doses of Umbradil, in spite of the fact that a reduction of the cerebral flow was always seen. With larger doses and higher concentrations some electroencephalographic disturbances were recorded, coinciding with larger changes in the systemic circulation. These disturbances were probably caused by the circulatory failure in combination with local vascular factors. The electroencephalogram was not followed for longer periods after the injections.

The authors conclude that since there was no simultaneous reduction in the systemic blood pressure, the decrease in the cerebral blood flow after the injections of Umbradil into the carotid artery of the cat can be due only to cerebral vasoconstriction. This vasoconstriction is attributed to a direct effect on the blood vessels, since procedures influencing the regulation of vasomotor tone, such as changing the depth of anesthesia or sectioning the spinal cord, the vagi, and the cervical sympathetic trunks, were all without effect upon the results. Although Umbradil has a high viscosity, a mere increase in the viscosity of the blood passing through the brain can hardly explain the decrease in flow, since the effects of the injections were less when

repeated several times and were not even noticeable when damage of the walls of the vessels had definitely occurred. Support for the assumption of cerebral vasoconstriction was also obtained in the general increase in vasomotor tone seen after injections of larger doses of the contrast media.

The results presented do not, therefore, afford experimental evidence for the view that Umbradil in doses and concentrations comparable to those employed in clinical cerebral angiography has any significant injurious effect upon the central nervous system as far as can be ascertained from the electroencephalogram.

Two figures. RITA BRADY, M.D.
University of California, S. F.

EEG During Cerebral Angiography. David H. Ingvar. Acta radiol. **47:** 181–184, March 1957. (University Hospital, Lund, Sweden)

A number of clinical and experimental observations have demonstrated that contrast media of the Diodrast type may produce cerebral vasomotor phenomena. An investigation was therefore carried out in order to determine whether contrast injections during various forms of routine cerebral angiography will produce any acute changes in the electroencephalogram. Seventeen patients were studied. All but 2, with congenital heart disease, were neurosurgical cases. Except in the 2 cardiac cases, the examinations were conducted without anesthesia. For carotid angiography (9 cases) the percutaneous technic was used and for vertebral angiography (6 cases) the catheter method of Radner. For the cerebral angiography Umbradil 35 per cent injected in doses of 10 ml. at a time was employed. For cardioangiography, 20 ml. of Umbradil 70 per cent were injected through a catheter into the left side of the heart.

In none of the 17 patients investigated did the electroencephalogram show any acute changes during or immediately after the injections of Umbradil, nor were there any clinical signs of neurological complications arising from the angiographic procedures. In 3 patients, however, a slight increase of previously existing slow waves (delta activity) was noted. This, however, did not appear until a few hours after or the day following the procedure.

The results indicate that the cerebral vasomotor changes which can be assumed to accompany cerebral angiography (see preceding abstract) do not influence the electric activity of the brain. The investigation does not support the view that routine cerebral angiography as a rule influences cerebral functions harmfully. On the other hand, the general impression is confirmed that patients with some local or general disturbance of cerebral circulation existing prior to angiography may tolerate the procedure less well. This is in accord with the fact that in 3 cases in which focal slow waves were found in the first electroencephalogram there was a slight increase of the pathological activity after angiography. RITA M. BRADY, M.D.
University of California, S. F.

EEG after Angiocardiography. Lennart Kirstein, Gunnar Jönsson, Johan Karnell, and Jan Philipson. Acta radiol. **47:** 169–176, March 1957. (Södersjukhuset, Stockholm, Sweden)

It is a well known fact that cerebral angiography with contrast media of the Diodrast type may give rise to cerebral complications. Previously (1952) Melin reported the effect of angiocardiography on the electroencephalogram in children. This report is of a similar investigation but concerned predominantly with adults.

Twenty-nine patients, 19 male and 10 females, were examined. In 20 cases thoracic aortography was performed, in 7 the contrast medium was injected into the pulmonary artery and in 2 cases into the right ventricle. The catheterizations were made under local anesthesia but angiocardiography was performed under narcosis with controlled respiration, the narcosis consisting of the intravenous injection of pethidine hydrochloride. In 26 cases, Umbradil 70 per cent in dosages of 1–1.5 ml. per kg. of body weight was injected; in the remaining 3 cases a corresponding quantity of triiode compound was used (Rheopac, Triurol, Urokon). The injection speed was 20 to 30 ml. per second.

With aortography a slowing of the activity in 4 cases out of 20 was observed. When the contrast material was injected into the pulmonary artery similar changes were seen in 2 out of 7 patients. In 5 cases these changes had disappeared within a week, in 1 case after two weeks. In 3 cases a diminution of episodic and paroxysmal activity was seen after angiocardiography; further EEG recordings were unfortunately only performed in 1 of these. This decrease of abnormality may have been caused by the contrast medium. Foltz *et al.* (J. Neurosurg, **9:** 68, 1952. Abst. in Radiology **59:** 789, 1952) observed a flattening of the activity in some cases. It may also have been due to chance as it is a well known fact that episodic and paroxysmal activity may change from one day to another in the same subject.

It is concluded that angiocardiography with the technic employed in this investigation does not bring about any severe or long standing cerebral damage as revealed by the electroencephalogram. The authors are of the opinion that the EEG abnormality observed in their series was due solely to the action of the contrast medium rather than to the narcosis or the anesthetic technic. However, after superficial narcosis, EEG changes may be seen due to the anesthetic effect on the brain, as well as after deep narcosis in which a certain degree of anoxia may be responsible. In this group of patients the anesthetics employed had a very transitory effect on the brain and there was no deep or prolonged narcosis, the patient being awake in ten minutes.

In Melin's series, there was a rather high percentage of abnormality after aortography as compared to the rather insignificant changes in the present investigation. A possible explanation offered for this discrepancy may be because Melin's group was comprised of children and the immature brain is very susceptible to injury. Also, following injury, the EEG in children often takes a longer time to stabilize than it does in the adult. In addition, if narcosis was deep and long, the pathologic activity may also be due partly to anoxia.

Three tables. RITA M. BRADY, M.D.
University of California, S. F.

Tomography of the Temporal Bone in Disease of the Middle Ear. D. C. James. Brit. J. Radiol. **30:** 148–152, March 1957. (Charing Cross Hospital, London, W. C. 2, England)

The author describes the technic for tomography of the temporal bone in disease of the middle ear and states that this method of examination appears to provide better visualization than routine straight roentgenog-

raphy and makes easier the detection of changes in a region where early diagnosis is of great value to the surgeon.

Tomography is carried out in the lateral oblique and in the anteroposterior positions. For the first of these the head rests on a Perspex angle board and is rotated from the lateral toward the affected side. The sagittal plane is rotated 20° about an axis which is parallel to the table top. The central ray is directed through a point 3 cm. behind the opposite external auditory meatus. Four cuts are taken at 0.5 cm. intervals, commencing 2.0 cm. deep to the affected ear. In the second position the head is held in the anteroposterior position, with Reid's base line perpendicular to the table top. The centering point is in the midline of the face between the two meatuses. Three cuts are taken, one 0.5 cm. behind the posterior wall of the external auditory meatus, another at the level of the posterior wall of the external auditory meatus, and a third at 0.25 cm. in front of this.

The author discusses the normal anatomy of the middle ear and the normal radiological appearances, as well as the radiological appearances in diseases primarily involving this structure.

In the small number of cases which have come to surgery, the findings have been in support of the preoperative radiological diagnosis.

Seven roentgenograms; 4 diagrams; 1 table.

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University of Missouri

The Bony Orbital Walls in Horizontal Strabismus. Hoda Abdel Aziz Zaki and Arthur Hail Keeney. Arch. Ophth. **57:** 418–424, March 1957. (A. H. K., 1410 Heyburn Bldg., Louisville 2, Ky.)

The purposes of the present study were (1) to establish normal radiographic values for the angulations of the orbital walls in orthophoric persons of different sex, age, and race, and (2) to analyze such bony orbital angles in relation to various horizontal imbalances. Accommodative, paralytic, and vertical heterotropias are excluded.

Submentovertex roentgenograms were taken to define the relationships of the bony orbital walls in horizontal section in 68 orthophoric control patients (age three to thirty-three years) and in 66 patients with purely horizontal, nonaccommodative, and apparently nonparalytic strabismus (age eight months to twenty-five years).

The angle formed by the medial and lateral wall of each orbit (designated Angle 1) was equal on the right and left side in 55 per cent of the orthophoric patients studied; in the remainder there were slight inequalities, averaging about 1.5° and ranging below 10°.

Twenty-five per cent of patients with monocular esotropia showed significantly smaller Angle 1 values (differing by amounts up to 21°) on the side of the deviating eye. No significant inequalities were found between right and left Angles 1 in cases of alternating esotropia in this series.

Thirty-three per cent of monocular exotropic patients showed significantly larger Angle 1 values (differing by amounts up to 11°) on the side of the deviating eye.

As part of the routine evaluation of patients with nonaccommodative and nonparalytic horizontal muscle imbalance, a routine submentovertex roentgenogram should be taken, from which the right and left orbital angles may be measured. Twenty to thirty-five per cent of such patients with monocular deviations may be expected to have significant inequality between the right and left bony orbital walls, associated with the direction of deviation. Where such structural irregularities exist, corrective surgery may better be undertaken at an early rather than a mature age, and as a monocular rather than a binocular procedure. Conversely, where the bony orbital angles are found to be equal, as in the alternating patients presented, the use of symmetrical or bilateral surgery would seem to be indicated.

Two roentgenograms; 1 drawing; 6 tables.

Hydatid Cyst of the Orbit Demonstrated by Pneumatomography. Maurice H. Luntz. South African M. J. **31:** 286–287, March 23, 1957. (Groote Schuur Hospital, Cape Town, Union of South Africa)

A case of orbital hydatid cyst in a 17-year-old colored male is presented. Straight roentgen examination proved of negative value but orbital pneumatotomography demonstrated a round mass situated in a posterior superior and temporal position behind the left globe. The outline was such a perfect sphere that a cyst was suspected. Peculiarly enough, this measured the same across as the normal globe.

At operation a hydatid cyst, exposed at the site indicated on the films, broke during blunt dissection. Its contents were evacuated, the endocyst was removed, and the ectocyst swabbed with formalin. The patient made an uneventful recovery. It is believed that the risk of orbital exploration outweighs that of possible rupture of the cyst or a hemangioma by the needle or the pressure of air injected.

One tomogram.

THE CHEST

Morphologic-Functional Bronchography: A Three-Stage Technic. M. Popper and A. Wolf. J. franç. de méd. et chir. thorac. **11:** 261–273, 1957. (In French) (Centre Pneumologique "Elena Pavel" de la Clinique Phtisiologique, Bucharest, Romania)

Bronchography should be performed in such a manner that functional as well as morphologic data may be obtained. The approach is threefold.

In the first phase, attention is given to expansion and ventilation of the lungs. The force of penetration of air is conditioned by the resistance encountered in the tracheobronchial tree. The lowering of resistance favors the progression toward the periphery of the current of air which carried with it the contrast substance introduced. The speed and volume of the penetration indicate to a degree the capacity of inspiratory expansion. If the contrast substance is introduced through a catheter, the value of this observation is modified by the force of injection from the syringe. The force of gravity also affects this observation, so that the patient should be in the recumbent position.

The second phase consists of the demonstration of the bronchial branches and the modifications of the parenchyma communicating with them. This is more difficult in methods which do not employ a catheter or sound, especially in many pathologic states . However, by changing the position of the patient the force of gravity will aid this phase. On the other hand injection through a guided catheter or sound may enable one to make a selective injection, lobe by lobe, segment by segment. A roentgenogram is taken after injection to

serve as a record of the morphologic characteristics of the tracheobronchial tree.

The third phase has for its objective the identification and interpretation of the movements of the bronchial tree. One may study these movements during fluoroscopy and may record them by taking roentgenograms in forced inspiration and expiration or by cineroentgenography. Characteristic expansion and contraction may be demonstrated if the bronchi are normal. This may be modified by various diseases or by previous lobar or segmental resection.

Twenty roentgenograms.

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Pulmonary Changes Following Bronchography with Dionosil Oily (Animal Experiments). Lars Björk and Herman Lodin. Acta radiol. **47**: 177–180, March 1957. (University Hospital, Uppsala, Sweden)

Dionosil Aqueous and Oily are two of the more recent contrast media available for bronchography. Unlike Lipiodol and Jodipin, in which the iodine is bound to unsaturated fatty acids of poppyseed and sesame oil, these newer preparations are based on the suspension principle, the opaque material being suspended in water or ground nut oil. The oil in Dionosil is said to be broken down into glycerine and "species-specific" fatty acids, the absorbability of which is believed to be much greater than that of the break-down products of the earlier iodized oils.

To determine experimentally the absorbability and the local effect on the lung tissue of the oily component of Dionosil, bronchography was performed with this medium in 20 rabbits. These animals, together with 10 controls, were kept under identical conditions. Histologic examination of the lung tissue for the retention of the fatty substance and parenchymatous lesions was made three months after bronchography in half of the experimental series, and six months after bronchography in the other half, as well as in the controls. It was observed that there was considerable retention of oily component after as much as six months, with areas of pathological changes in the lung tissue which, as far as granulomata are concerned, were more numerous than after three months. No pathological changes were observed in the control group.

In so far as animal experiments such as these can be applicable to man, the authors conclude that the oily suspension of Dionosil should be abandoned in favor of the aqueous suspension. Although the aqueous suspension contains the viscosity-raising factor, carboxymethyl cellulose, which is irritating to the lung tissue, the content is smaller than that of such water-soluble media as Umbradil Viskös B and Joduron B.

Three photomicrographs, in color.

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Mass Radiography Associated with a General Hospital. F. Pygott. Lancet **2**: 1348–1352, Dec. 29, 1956. (Central Middlesex Hospital, London, England)

The experience with a mass radiography unit working as part of the radiological department in a general hospital in the three-year period 1953–1955 is described. Nearly all new adult outpatients attending the hospital during the period were radiographed, together with as many inpatients as possible. Patients were also referred directly by general practitioners. Other sources of reference were surrounding industries, area medical officers, contacts, and hospital staff. Altogether 97,362 patients were examined.

Active pulmonary tuberculosis was not discovered in an unusually high proportion of hospital patients (3.4 and 5.1 per 1,000 for outpatients and inpatients respectively), but the rate of 4.5 per 1,000 among patients referred by general practitioners was four or five times as high as in the general population. The total number finally classified as tuberculous was 465. More than a third of these were sputum-positive, and nearly a half required hospital or sanatorium treatment. The rate for men was highest after the age of forty-five (2.9 per 1,000) and was much greater than in women.

One hundred and seventeen primary pulmonary neoplasms were discovered, in 89 men and 19 women. Here again the highest rate (3.8 per 1,000 of all ages and sexes) was in the patients referred by their own doctors. No tumor was dectected in patients less than thirty five years of age. Ninety-three of the neoplasms were in men over forty-five; the same group provided 42 of the cases of sputum-positive pulmonary tuberculosis.

Two figures; 7 tables.

Advantages of Hospital Admission Chest X-Ray Examinations. Abraham Melamed. J.A.M.A. **163**: 718–720, March 2, 1957. (620 N. 19th St., Milwaukee 3, Wis.)

Despite the fact that routine hospital admission chest x-ray examinations are performed in only 30.1 per cent of the hospitals in the United States, there are many excellent reasons why the practice should be universal. Routine chest x-ray examination would aid in decreasing communicable diseases in the hospital population. Cost of hospital compensation insurance would probably decrease, as there would be fewer claims against the hospital. Many unsuspected cases of chest disease amenable to treatment would be discovered. Some errors in diagnosis of chest diseases would be avoided. The routine admission chest film would be helpful in evaluation and preparation of the surgical patient. It would serve as a record of the past condition of the chest and would be of significance in compensation and accident cases.

Pulmonary tuberculosis accounts for about 10 to 15 per cent of the significant positive findings in patients admitted to general hospitals. The rate of tuberculosis among hospital patients is two to eight times the rate found in mass surveys.

Routine admission chest studies are also of value as a method of detecting unsuspected cancer.

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Lung Changes in Pertussis and Measles in Childhood. A Review of 1894 Cases with a Follow-Up Study of the Pulmonary Complications. John Fawcitt and H. E. Parry. Brit. J. Radiol. **30**: 76–82, February 1957. (Monsall Hospital, Manchester, England)

The authors review 1,894 cases of pertussis and measles seen between January 1948 and June 1955, in which chest films were available.

Lung changes demonstrable radiologically were subdivided into atelectasis, consolidation, hilar node enlargement, bronchopneumonia, and infiltration. By infiltration is meant an appearance that is found mainly in the viral interstitial pneumonic phase of measles, and also in certain cases of pertussis, where loss of trans-

lucency of the lung fields does not amount to bronchopneumonia or to lobar pneumonic consolidation.

Atelectasis of varying degree was found in 48 per cent of the cases of pertussis and in rather more than half of these it was present in more than one lobe. The lower lobes were involved most commonly, with little difference between the right and left sides. Children over one year were affected twice as frequently as those under one year. A possible explanation for this variation is that infants produce less mucus in the respiratory tract than do older children.

Pneumonic consolidation occurred in only 8.6 per cent of the children, and these again involved chiefly the lower lobes, plus the right middle lobe. Hilar node enlargement was present in 30.3 per cent of the patients with pertussis, bronchopneumonia in 12.8 per cent, and infiltration in 5.3 per cent.

The radiologic pattern of measles shows less atelectasis but more frequent hilar node enlargement and infiltration. Atelectasis was present in 28.4 per cent of the measles cases, and in less than half was this multiple. Lobar and age distribution was similar to that in pertussis. Consolidation also occurred in about the same percentage of children as in the pertussis group. The incidence of hilar node enlargement was 63.6 per cent, and of infiltration 21.3 per cent. It is here that the measles cases differ most markedly from pertussis. Bronchopneumonia was present in only 15.8 per cent of the children with measles.

The authors feel that permanent residual changes in the lungs as a result of pertussis and measles are now rare and that there is no significant difference in the frequency of residual lung changes between the two diseases. The length of time required for complete clearing is stressed.

Seven roentgenograms; 6 tables.

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"Pneumocystitis Carinii" Pneumonia. T. Bird and J. Thomson. Lancet **1**: 59–64, Jan. 12, 1957. (Department of Pathology, University of St. Andrews, St. Andrews, Scotland)

From the atypical pneumonias of infancy, European observers have separated a specific clinical and pathological entity which they call interstitial plasma-cell pneumonia. This disease, as seen on the Continent, affects chiefly premature and immature weakly infants, aged two to five months. Although it is sometimes preceded by diarrhea or an acute infection of the upper respiratory tract, its onset is generally insidious, mild ill health being followed by tachypnea, dyspnea, and cyanosis; these symptoms increase gradually or rapidly, and death, if it takes place, occurs with extreme asphyxia. Objective findings are curiously slight: there is little or no fever, and examination of the chest may disclose nothing abnormal. Characteristic of the fatal cases is the fact that the radiological changes, from an early stage of the disease, are of a striking degree and quite out of proportion to the symptoms and signs.

The authors present 2 fatal cases of pneumocystitis pneumonia in infants. Of the 4 cases now reported from Scotland, 2 showed extreme deficiency of gamma globulin ("agammaglobulinemia"). Three of the infants were older than those seen on the Continent with this condition. Histologically the changes agree closely with those seen in the interstitial plasma-cell pneumonia of the European continent, the two main features being an intra-alveolar "exudate" of unusual foamy or granular appearance and thickening of alveolar septa by an infiltrate of mononuclear cells, often rich in plasma cells. Attempts to isolate the causal agent were unsuccessful. The radiographs in the authors' cases showed a widely disseminated granular process in the lung fields; on detailed inspection the opacities have a fluffy outline, unlike discrete miliary lesions. There is no evidence of hilar nodal enlargement. The pattern progresses to more widespread and confluent fluffy opacities. The general impression is that of a disseminated alveolar lesion becoming lobular and ultimately widespread.

Two cases have been seen in the United States and 5 in Canada.

Five roentgenograms; 2 photomicrographs.

Cancer of the Lung: An Analysis and Evaluation of 100 Consecutive Cases. Clarence A. Bishop. J. Thoracic Surg. **33**: 330–340, March 1957. (VA Hospital, Little Rock, Ark.)

The author analyzes 100 consecutive cases of lung cancer seen on the surgical service of the Little Rock, Arkansas, Veterans Administration Hospital. Forty-one patients had bony or other distant metastases on admission. In 18 cases there was no evidence of metastases but the tumor was clearly non-resectable for other reasons, such as mediastinal invasion or positive pleural fluid. In 20 patients preoperative studies indicated resectability, but at surgery the tumors were found to be non-resectable. In 21 patients resection was performed.

Survival figures make it clear that exploratory operations significantly reduced life expectancy in non-resectable cases. In this group, mean survival time was less than four months, whereas the patients who showed obvious contraindications to surgery, although without evident metastases, survived for a mean of ten months.

The author found that planigrams and bronchograms were the most reliable of studies for determining resectability preoperatively. In some instances, body-section roentgenograms were more revealing in the semi-oblique than in the conventional vertical projection.

It is stressed that surgery must be early to be effective, and operations must be performed on suspicion of cancer. Every available means should be thoroughly exploited preoperatively to determine resectability.

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Contribution to the Radiomorphologic and Anatomicoclinical Studies of Pulmonary Adenomatosis. G. Voluter and W. Zürcher. Radiol. clin. **26**: 59–74, March 1957. (In French) (G. V., Institut de Radiologie Médicale de l'Université de Genève, Geneva, Switzerland)

Using as a text a case of pulmonary adenomatosis in a 70-year-old woman, the authors present an interesting discussion of this disease. The patient had had respiratory symptoms for many years, with dyspnea on effort and constricting retrosternal pains. She had lost weight (5 kilos) and had a *non-productive* [italics are abstracter's] cough. Her nutrition was relatively good. Because acid-fast bacilli were reported in the sputum, the miliary disease in the chest was called tuberculosis. The numerous nodular foci were of large caliber but without a uniform distribution, resembling silicosis. There were four important areas of conflu-

ence, with a small excavation. At autopsy, adenomatosis of both lungs was discovered. No metastases were present.

The questionable nature of pulmonary adenomatosis, whether benign or malignant, is discussed. It is impossible to predict the metastasizing potential from the cytology. Perhaps 50 per cent of all cases will metastasize. The origin of the cell, whether intra-alveolar or bronchiolar with extension into the alveoli, is not certain. The method of metastasis resembles that of the usual bronchogenic cancer. The disease favors the female in contradistinction to the usual variety of lung cancer. The latent period may be long.

The roentgenographic picture is discussed in detail. The more common sites of involvement are the middle and lower portions of the lung. The miliary distribution is not regular, but suggests a "snowstorm," as in silicosis. This comparison was strengthened by the presence of intervening emphysema in the authors' case. The foci of confluence resembled "branches of a fir tree covered with snow."

Tomography has been neglected in the study of adenomatosis of the lung. This procedure gives considerable information concerning the parahilar distribution of any nodular dissemination. It also demonstrates the state of the hili themselves, as well as propagation of the process from the hilus to the periphery and vice versa. This information is of considerable importance in distinguishing adenomatosis from siljcosis. The latter initially is a hilar and not a parenchymatous process. At first, the alveoli are able to take care of the offending material, directing it into the hilar nodes.

A number of conditions require differentiation:

1. *Carcinomatous lymphangitis* is usually associated with neoplasms of the breast; it is always radial, faithfully adhering to the direction of the lymphatics. Usually it is unilateral and situated in the lower portion of the lung. It is striate with a nodular pattern. The pleura is involved early, with effusion. While pleural involvement occurs also in adenomatosis, it is rarely early. However, the neoplastic alteration of the alveoli in adenomatosis is often manifested by a striate pattern resulting from lymphatic stasis from compression of the rigid alveoli. Bronchoscopically, one may see blocking in the peripheral bronchial segments from this compression, but this is not specific.

2. *Carcinomatous metastases* may resemble adenomatosis, but generally the foci are of differing caliber.

3. In *tuberculosis (miliary)*, all the sections of the lung are homogeneously involved. Exceptionally, however, miliary tuberculosis can be found locally, but the foci are thicker-set and more homogeneous.

4. The *Schneeberg occupational cancer of the lung* is probably due to a combination of cobalt, arsenic, and silicic acid inhalation. It too is an epithelial cancer of the alveolus. However, only rarely is it miliary, since early in the course there is considerable distortion of the lungs by fibrous retraction.

5. Since adenomatosis attacks especially the female, *metastases of chorionepithelioma* should be considered. However, the whole clinical picture differs.

6. In *lymphogranulomatosis of the lung* tomography will again demonstrate a picture similar to carcinomatous lymphangitis. Only the clinical examination will differentiate these two diseases.

7. *Miliary leukemic infiltrations*, like adenomatosis, show a predilection for the medial and lower portions of the lung. In addition, they resemble cancerous lymphangitis. Only the clinical picture will determine their true nature.

8. Most cases of *Boeck's sarcoid* show a localization similar to miliary tuberculosis, homogeneous and symmetrical. Pulmonary sarcoidosis, however, is frequently accompanied by hilar lymph node enlargement.

Six roentgenograms; 2 photographs.

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Alveolar Cell Tumor: Report of a Case and Evaluation of Diagnostic Procedures. Charles L. Ferguson and Ralph C. Parker, Jr. Ann. Int. Med. **46**: 600–611, March 1957. (R. C. P., Jr., U. S. Naval Hospital, National Naval Medical Center, Bethesda 14, Md.)

Alveolar-cell tumor (pulmonary adenomatosis, bronchiolar carcinoma) is a condition to be considered in the differential diagnosis of both discrete and diffuse pulmonary lesions. The following case is of interest, for a chest film was reported as normal a relatively short time before the abnormal film was taken. The progression of the disease was well demonstrated by serial x-ray examinations over a period of approximately eighteen months.

This patient had been radiologically and physically normal two months prior to admission. Within six weeks of the first examination, equivocal x-ray changes were apparent in both lung fields. Bronchoscopic visualization was not helpful. Bronchial washings were negative for tumor cells. The diagnosis was made by biopsy and confirmed at autopsy.

While alveolar-cell tumors usually present either a nodular or a diffuse pattern, a small percentage show pleural effusion or cavitation. Not infrequently the earliest x-ray finding will be a solitary circumscribed peripheral lesion in the lung. Recognition of the disease depends on microscopic examination of tissue.

At no time did the authors' patient seem to be a good candidate for resection, since the process appeared to be bilateral from the start. Resection would seem to be the procedure of choice in cases where, radiologically, the disease appears to be localized to one lobe. External radiation therapy is only slightly palliative, if effective at all.

Four roentgenograms; 2 photomicrographs.

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Alveolar Cell Carcinoma of the Lung Radiologically Silent. J. Turiaf, P. Marland, and C. Sors. J. franç. de méd. et chir. thorac. **11**: 115–125, 1957. (In French) (Paris, France)

A 65-year-old male who complained of severe respiratory insufficiency was found roentgenographically to have bullous emphysema. Later he suffered a spontaneous pneumothorax. Treatment was temporarily beneficial, but later the patient became worse and expired. At autopsy, multiple small nodular tumors were found in both lungs, which on microscopic examination proved to be alveolar-cell carcinoma.

Alveolar-cell tumor may occur as a local mass or as multiple small, slowly growing nodular tumors. It accounts for 2 to 5 per cent of primary pulmonary neoplasms and occurs about equally in both sexes.

One roentgenogram; 1 photomicrograph.

CHARLES M. NICE, JR., M.D., Ph.D.
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Lipoma of the Bronchus: Report of a Case. Seymour Ochsner, Francis E. LeJeune and Alton Ochsner. J. Thoracic Surg. **33:** 371–378, March 1957. (Ochsner Clinic, New Orleans, La.)

From 5 to 10 per cent of bronchial neoplasms are benign. Lipoma of the bronchus is one variety which is rather rare. These tumors are most commonly located in the larger bronchi in the hilar region; they may arise internal or external to the cartilaginous plates. Endobronchial expansion creates symptoms and leads to varying degrees of obstruction, atelectasis, pneumonitis, bronchiectasis, and so on.

The earliest x-ray manifestation is likely to be an unusual density or configuration in the hilar shadow. Serial roentgenograms may reveal gradual increase in size. Bronchograms may show a polypoid growth producing an endobronchial filling defect. Stenosing bronchial growths will produce narrowing of the bronchial lumen, either complete or incomplete, associated with bronchial dilatation proximally or bronchiectasis distally. The degree depends upon extent and duration of the tumor growth. Plain films may reveal the usual findings associated with bronchial obstruction, such as localized emphysema or atelectasis.

On bronchoscopy the lesion usually appears as a smooth, submucosal mass. It is firm and gray or yellowish in color. The overlying mucosa is stretched, but rarely ulcerated.

Prompt excision is indicated, as these tumors are "benign only in the histologic sense."

Three roentgenograms; 1 photograph; 1 table.

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Benign Pulmonary Histoplasmosis (Cave Disease) in South Africa. J. F. Murray, H. I. Lurie, J. Kaye, C. Komins, R. Borok, and M. Way. South African M. J. **31:** 245–253, March 16, 1957. (South African Institute for Medical Research, Johannesburg, Union of South Africa)

This is believed to be the first discussion in African literature of the occurrence on that continent of so-called cave disease, the benign, as opposed to the fatal, form of pulmonary histoplasmosis. The authors followed four main lines of investigation: (1) obtaining from past and present members of the Transvaal Speleological Society a complete medical history, including chest roentgenography and histoplasmin sensitivity tests; (2) observing all new members of the Society before and after visits to suspected caves; (3) attempting to isolate *H. capsulatum* from the soil, atmosphere, and fauna of caves in the Transvaal; (4) exposure of experimental animals in caves in which the disease was contracted by man.

As a first step, a comparison was made between actual cave explorers (speleologists), students, and laboratory workers as to histoplasmin sensitivity. Among 56 speleologists, histoplasmin skin tests were positive in 54, or 94.5 per cent; a student group of 39 persons without experience in exploration showed no positive tests, nor did any of a group of laboratory workers not coming into contact with mycological specimens. On the other hand, 12 per cent of workers in a laboratory where strains of *H. capsulatum* were maintained reacted positively.

Of the speleologists, 82.1 per cent gave a history consistent with the occurrence of benign histoplasmosis. Furthermore, the histories showed that the condition occurs in epidemic form whenever a new group joins the Society. Three typical epidemics are described.

The history of an appearance of acute respiratory infection five to eighteen days after spending some hours in cave exploration was encountered in many of the subjects brought forward by the Society. These could be divided into three groups: in 26 of 29 persons of the first group, diagnosis could be established in retrospect, and there were 3 negative reactors; Group 2 was comprised of 10 subjects who were first observed during or shortly after the acute stage of illness: in Group 3, there were 14 new members who were kept under observation throughout their activities with the Society. In each instance an attack of pneumonitis followed exposure in a cave known to be infected. The severity of the illness was directly related to the period of exposure.

In all cases observed, the pattern of the illness was uniform. Between five and eighteen days after exposure, the patients complained of lassitude, pains in the limbs and joints, backache, headache, pyrexia, coryza, and nonproductive cough. Dyspnea was a common feature and in some cases persisted after the acute attack. In severe cases rigors were not uncommon.

Radiological examination of 19 cases during the acute stage of the illness showed a widespread miliary nodulation in 7; a patchy loss of translucency, similar to the changes seen in a virus pneumonitis, in another 7; coarse, ill-defined, pea-sized nodules in 3, confined to the right upper lobe in 1 case and diffusely scattered in the other 2; a generalized increase in bronchovascular markings in 2, which might have been considered normal had the cases not been followed up and shown to clear completely later on. The only significant difference between the cases under the authors' observation and the American cases described by Grayston and Furcolow (Tuberculology **13:** 8–14, September 1952) was the absence of pulmonary calcification. The significance of this feature is obscure and will be the subject of further investigation.

Attempts to isolate the organism from the soil and atmosphere of the caves and from bats dwelling in them were unsuccessful. Monkeys, rabbits, guinea-pigs, rats, and mice were exposed in a cave where individuals invariably became infected. The features of the fungal strains recovered from these animals were identical with those from 5 fatal cases of histoplasmosis reported from South Africa and with classical strains of *H. capsulatum*.

Nine roentgenograms; 4 photomicrographs; 1 chart; 2 tables.

Mucoid Impaction of the Bronchi. Allen E. Greer. Ann. Int. Med. **46:** 506–522, March 1957. (A. E. G., 430 Northwest Twelfth, Oklahoma City 3, Okla.)

The existence of dilated bronchi filled with inspissated mucus complicating asthma or obstructive bronchitis has been recognized, but few cases have been reported. Five additional examples are presented here.

The underlying cause is not clearly understood. Shaw's original report (J. Thoracic Surg. **22:** 149, 1951. Abst. in Radiology **59:** 131, 1952) stated that the mucoid impaction of the bronchi resulted from a localized accumulation of inspissated mucus in bronchi of the second order, distal to a bifurcation. This was borne out by the author's 5 cases. The dissected specimens showed huge bronchi, the largest 2 cm. in diameter. The mucus is putty-like, brown to greenish-

gray. In some areas peripheral to these masses, clear viscid mucus may be present, or there may be purulent material about the mucous masses or peripheral to the obstructed bronchi.

All 5 of the cases reported here were in upper lobes, but one also involved the superior division of the lower lobe. This predilection for the upper lobe, observed also by Shaw, may be of aid in distinguishing residual bronchiectasis from the usual variety, which more often involves the basal segments of the lower lobes.

Symptoms of mucoid impaction of the bronchi are similar to those of asthma or chronic obstructive bronchitis (wheezing respiration, dyspnea, cough, and often a history of allergy). Physical examination is of no aid in the diagnosis, as the findings are those of the underlying asthma, obstructive bronchitis, or secondary inflammation.

Roentgenograms show shadows with rather distinctive characteristics. In patients without secondary infection, the plugs cast a V-shaped shadow, with the vertex of the V toward the hilus. Atelectasis of varying degree is present in some cases. In the presence of secondary infection there are ovoid peripheral shadows reaching the pleural surface. If some of the plugs are expectorated, an air cavity may be evident, or an air-fluid level may be seen in an abscess cavity. As the mucus becomes liquefied or as expectoration clears the pneumonitis, the bronchi remain dilated and there are typical findings of bronchiectasis in unusual locations. These may be seen as cystic, mottled areas in plain views. The dilated bronchi are outlined in bronchograms. No contrast medium enters the bronchi if the mucus has not been evacuated. Planigrams may be of aid in demonstrating the character of the shadow and in viewing bronchi which have been evacuated. The large dilated bronchi which remain may be mistaken for the cavities of tuberculosis. The presence of a shadow on the chest roentgenogram in a patient with asthma or obstructive bronchitis is suggestive of the diagnosis.

Treatment is chiefly medical. The indications for surgery are the persistence of secondary suppurative disease, persistent hemoptysis from bronchiectasis, and the need to obtain an exact diagnosis. The differentiation between carcinoma and mucoid impaction of the bronchi is important, so that lung tissue may not be unnecessarily sacrificed.

Twelve roentgenograms; 2 photographs.

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THE HEART AND BLOOD VESSELS

Selective Angiocardiography in Congenital Heart Disease. Russell A. McFall, Wallace O. Austin, Forrest H. Adams, and Bernard J. O'Loughlin. California Med. **86:** 162–168, March 1957. (B. J. O., U. C. L. A. School of Medicine, Los Angeles 24, Calif.)

Angiocardiography is attended by certain risks and limitations and definite indications must therefore be present before its performance. Where there is serious progressive heart disease without an exact diagnosis and the final issue is in doubt, the use of this procedure is to be considered. It affords information as to type of defect, anatomical orientation for the surgeon, and confirmation of clinical diagnosis.

In the diagnosis of congenital heart lesions the authors have used conventional venous angiocardiography in less than 20 per cent of their cases. Selective angiocardiography devised by Chavez is their procedure of choice. The heart is catheterized and the tip placed for best demonstration of the structures about which information is desired. A single rapid injection of opaque material (usually 70 per cent Urokon) in small quantity permits study of both ends of the opacified blood column as it passes to the various chambers of the heart. A combination of high-speed film-changing and short exposures is imperative. The quantity of material injected depends on the size of the patient and the size of the chamber to be studied.

Five case reports are included, illustrating instances of coarctation of the aorta, endocardial fibroelastosis, Ebstein's anomaly of the tricuspid valve with patent foramen ovale, tetralogy of Fallot, and patent ductus arteriosus with coarctation of the aorta.

Fourteen roentgenograms.

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Springfield, Ohio

Roentgenographic Evaluation of Coarctation of the Aorta in Infants. Richard G. Lester, Alexander R. Margulis, and Charles M. Nice, Jr. J.A.M.A. **163:** 1022–1026, March 23, 1957. (R. G. L., 412 Union St., S. E., Minneapolis 14, Minn.)

Coarctations of the aorta are classified in relation to the position of the ductus arteriosus or ligamentum arteriosum. Thus, coarctation distal to the ligamentum or ductus is designated Type 1, (A) with ligamentum arteriosum and (B) with a patent ductus arteriosus. Coarctation proximal to the ligamentum or ductus is known as Type 2, (A) with a patent ductus arteriosus and (B) with ligamentum arteriosum. In cases of Type 1, there is a strong stimulus to the formation of collateral circulation around the coarctation. In Type 2, such stimulus is slight or absent, since the trunk and lower extremities receive their supply from the right side of the heart *via* the ductus arteriosus. The authors present material and observations from 30 cases of coarctation in which surgery or autopsy was performed in the first year of life. The coarctations were of Type 1 in 17 patients and of Type 2 in 13.

The diagnosis was not easily established in most of these patients because they presented the signs and symptoms of general cardiac disease. The most common problem was heart failure, which was observed in 19 cases. Seventeen patients had a history of cyanosis and all but 6 of the series had a murmur. The most important clinical sign is decreased blood pressure in the leg as compared with the right arm.

The roentgenographic findings in Type 1A consist of enlargement of the heart posteriorly and inferiorly as a result of left ventricular enlargement. Pulmonary vascularity is normal. In most patients the aorta is not clearly visible. Rib notching was not seen in any of the authors' patients. In Type 1B left ventricular and left atrial enlargement are present. A definite increase in pulmonary vascularity can be corre'ated with the degree of left-to-right shunt.

In Type 2A the right ventricle becomes a partial systemic pumper for blood to the trunk and lower extremities and, in uncomplicated cases, is considerably larger than the left. Pulmonary vascularity may be slightly increased. In Type 2B a marked strain is placed on the left ventricle. Both of the cases of this type in the present series showed left- and right-sided cardiac enlargement. The pulmonary vascularity appeared normal.

Special roentgenographic examinations such as retrograde aortography and angiocardiography are of great value in some cases.

Roentgenographic examination may suggest the diagnosis of coarctation in infants in whom it is not suspected. It may also aid in differentiation of the type of coarctation when the diagnosis has been suggested.

Ten roentgenograms. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Retrograde Brachial Aortography. Its Use in the Diagnosis of Patent Ductus Arteriosus and Coarctation of the Aorta in Infancy. Herbert L. Abrams and Saul J. Robinson. California Med. **86:** 169–172, March 1957. (Stanford University School of Medicine, San Francisco 15, Calif.)

Patent ductus arteriosus and coarctation of the aorta are among the commonest causes of congestive heart failure in early life. In infancy the ordinary clinical and roentgen findings of the patent ductus are not found with regularity and the diagnosis of coarctation of the aorta is not certain because of unreliable blood pressure determinations. Retrograde brachial aortography is an efficient method of determining the presence of these defects, differentiating intracardiac shunts and showing the length and position of coarctated segments. The left brachial artery is cannulated and opaque medium is injected against the blood current toward the aorta. Serial films record the passage of the contrast medium into the aortic arch and its branches.

The authors used the procedure in 84 patients, most of whom were under three years of age. Thirty-five per cent Diodrast was injected in 77 cases and a 70 to 75 per cent concentration of the medium in 7 cases. A number of serious complications were encountered in the latter group, and death was recorded.

Forty-four studies were normal, and 6 examinations were unsatisfactory. The latter included 3 mistaken diagnoses. In 14 cases, the presence of patent ductus arteriosus with left-to-right shunt was shown. In all but 1 of these the diagnosis was proved at operation. The presence of coarctation of the aorta was demonstrated in 15 patients. In 10 cases the diagnosis was proved at operation and in 2 at autopsy. In 1 case there was complete interruption of the aortic arch, with reversed flow through the ductus.

In the diagnosis of patent ductus arteriosus by cardiac catheterization, the pulmonary artery must be catheterized, a relatively difficult procedure under the age of twelve months. Even when catheterization is achieved, the distinction between patent ductus and ventricular septal defect is not always possible unless the ductus itself is entered. For this reason the authors prefer aortography in infancy and reserve cardiac catheterization for older age groups.

Five roentgenograms; 3 tables; 1 drawing.
JOHN F. RIESSER, M.D.
Springfield, Ohio

Carbon Dioxide as a Contrast Medium for Roentgenography of the Heart and Blood Vessels. F. Grosse-Brockhoff, D. Koch, F. Loogen, G. Rotthoff, H. Vieten, and K. H. Willmann. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 285–291, March 1957. (In German) (Röntgeninstitut der Chirurgischen Klinik der Medizinischen Akademie, Düsseldorf, Germany)

Carbon dioxide injected intravenously, even in large quantities, does not produce the severe symptoms of gas embolism that may follow the injection of air or nitrogen. In animals, repeated injection of large amounts is usually well tolerated. This is due to the high degree of solubility of carbon dioxide in the blood—twenty-one times greater than that of oxygen and twenty-four times greater than that of nitrogen. Carbon dioxide may therefore be injected in quantities large enough to act as a contrast medium for the radiographic demonstration of the circulation. This is of particular importance in patients hypersensitive to iodine.

The authors have performed interesting experiments on dogs (average weight about 50 pounds). Carbon dioxide, in amounts up to 7 c.c. per kilogram of body weight, was injected either intravenously or intracardially by means of a cardiac catheter at an average speed of 70 c.c. per second. No ill effects were observed, though in some of the animals there was a slowing down of the respiration and an increase in the respiratory excursions. The right auricle and also the pulmonary artery could be well outlined on the anteroposterior views. The right ventricle and the pulmonary outflow tract were well visualized in lateral projections.

On the basis of these experiences, the authors have used carbon dioxide for angiocardiography in 2 patients in whom routine iodine injections could not be made on account of hypersensitivity. In each the carbon dioxide was injected through a catheter into the right heart. In one of the cases a valvular pulmonary stenosis was well demonstrated.

The injection of carbon dioxide into the arterial system is still in the experimental stage. Not enough knowledge has been gained to predict what could happen if the gas should enter the coronary arteries or the arteries of the brain.

Seven roentgenograms.
WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

The Basis of Pneumoradiography of the Right Heart with Carbon Dioxide. W. Höffken, R. Junghans, and W. Zylka. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 292–301, March 1957. (In German) (Röntgenabteilung des Bürgerhospitals, Cologne, Germany).

The danger of air embolism makes the intravenous injection of air for the x-ray visualization of the right heart impossible. Carbon dioxide, however, can be injected in sufficient quantities with apparently little danger, because of its high degree of solubility in blood. In addition, an appreciable amount enters into chemical union with components of the blood. *In vitro*, 100 ml. of blood can absorb 62 ml. of carbon dioxide, as compared to 8 ml. of oxygen and 0.28 ml. of nitrogen. The absorption of carbon dioxide depends on the amount of the gas that comes in contact with the circulating blood in the unit of time.

The authors made fifty injections of carbon dioxide in various doses in rats, rabbits, and dogs. The heart frequency was not changed by the injection of small quantities, but in the dog and rat increased temporarily after a certain threshold dose was exceeded. The arterial blood pressure always showed a drop, which was larger with greater amounts of carbon dioxide. The electrocardiogram revealed changes in the QRS complex, extra systoles, depression of the ST interval, and inversion of T. The frequency and the volume of respiration were increased, but the percentage of CO_2 in the exhaled air did not deviate much from the normal.

Following the injection, the CO_2 content of the blood rose but the oxygen content fell.

Clinically no definite reaction is observed if a small or medium dose is given; with lethal doses, apnea and collapse suddenly follow about ten seconds after the injection. The lethal dose in the rat was 34 ml./kg., in the rabbit 6 ml./kg., and in the dog 20 ml./kg. The danger lies in the severe drop in the blood pressure which, according to these experiments, coincides with maximum cardiac filling and apparently leads to a blockage of the right heart. It is most severe if the animal is lying on its back. Following a drop in blood pressure down to about 10 mm. Hg, there is an acute ischemia of all organs, including the central nervous system. This was evidenced in the authors' animals by the appearance of convulsions about ten seconds after the injection. If this severe ischemia lasts longer than three minutes, death ensues.

Basically there is no difference between air embolism and carbon dioxide embolism, but the short period of the deleterious action of the latter gas makes it much safer.

The authors believe that the necessary amount of carbon dioxide for the demonstration of the right heart can be safely injected, the diagnostic dose being only one fourth of the lethal dose.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Isolated Congenital Mitral Stenosis: Report of Two Cases with Mitral Valvotomy in One. J. L. Braudo, S. N. Javett, D. I. Adler, and I. Kessel. Circulation **15**: 358–365, March 1957. (University of the Witwatersrand, Johannesburg, Union of South Africa)

Congenital isolated mitral stenosis is a very rare condition. To the 8 cases previously reported, the authors add 2, in 1 of which valvulotomy was done at the age of three months.

The first patient had respiratory symptoms from birth but was not seen until three months after the onset of congestive failure. Plain films showed cardiac enlargement, with signs of specific enlargement of both atria and the right ventricle, as well as pulmonary congestion. No diagnosis was made. The patient improved on digitalis but died one month later. At autopsy mitral stenosis and generalized fibroelastosis of the left atrial endocardium were fonnd.

The second patient was seen at three weeks of age, in congestive failure. Plain films again showed pulmonary congestion and enlargement of the right ventricle and both atria. Cardiac catheterization at seven weeks ruled out a shunt and suggested mitral stenosis because of the elevated right ventricular pressure. Angiocardiography, at three months, demonstrated mitral stenosis only. Surgery was done, and the patient had survived to the time of the report (sixteen months).

Three roentgenograms; 2 photomicrographs; 3 photographs; 3 tables; 2 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgen Contrast Diagnosis of Experimental Mitral and Aortic Insufficiency in Dogs by Transventricular Injection and Retrograde Catheterization. Robert J. Wilder, Howard L. Moscovitz, and Mark M. Ravitch. J. Thoracic Surg. **33**: 147–165, February 1957. (R. J. W., Baltimore City Hospitals, Baltimore, Md.)

The authors give the results of two procedures for the roentgen contrast demonstration of insufficiency of the mitral and aortic valves—direct puncture of the left ventricle and retrograde aortic and left ventricular catheterization.

A total of 158 radiographic studies were carried out in 38 dogs; 117 of these were performed by direct injection of 70 per cent Urokon into the left ventricle, according to the technic of Beato Núñez and Ponsdomenech (Am. Heart J. **41**: 643, 1951. Abst. in Radiology **58**: 897, 1952). Forty-one injections of Urokon were carried out with a No. 9 Lehman aortic x-ray catheter; under fluoroscopic control, the catheter was passed retrograde through an incision in the femoral artery, into the aorta, and positioned either above the aortic valve or in the left ventricle.

Roentgenograms of the normal heart obtained during the injection of contrast medium into the left ventricle by direct heart puncture and by retrograde arterial catheterization demonstrate the roentgen anatomy of the left heart in dogs as seen in the right lateral position. With either technic, the left ventricle, the aortic valves, the sinuses of Valsalva, the aorta, and usually the coronary arteries can be seen. To the right and inferior to the base of the aorta, the contrast medium in the left ventricle ends abruptly, forming a sharp crescent-shaped border. This margin represents the closed mitral valve. The normal competent mitral valve prevents visualization of the left atrium, which lies just posterior to this crescentic border. In this projection, the valve lies so that the posteromedial commissure is at the base of the aorta and the anterolateral commissure opposite. The outline of the ventricle is sharp and the entire ventricle is filled with contrast medium. The contour of the ventricular chamber differs depending on whether the film is taken in systole or diastole. Visualization of the aortic valve leaflets is especially clear.

When radiopaque material is injected into the ascending aorta through an arterial catheter, the sinuses of Valsalva, the coronary arteries, and the aortic valve leaflets are sharply visualized. No medium is seen in the left ventricle. In a series of 19 injections of contrast medium into the left ventricle by both technics, and 10 injections of contrast medium into the ascending aorta by retrograde arterial catheterization, complete competency of the mitral and aortic valves in normal dogs was demonstrated.

Mitral insufficiency is readily shown on roentgenograms by the injection of contrast medium into the left ventricle, since the incompetent mitral valve permits reflux of medium into the left atrium.

Aortic insufficiency can be detected when contrast material, injected through a catheter in the ascending aorta, regurgitates into the left ventricle.

The combination of mitral stenosis and insufficiency is radiologically demonstrated by the injection of contrast material into the left ventricle.

The injection of contrast material into the left ventricle through the retrograde aortic catheter appears to be safer than the direct puncture technic.

The possible application of the above technics for the diagnosis of valvular disease in man is discussed.

Twenty roentgenograms; 1 drawing.

The Angiocardiographic Demonstration of Superior Vena Cava Constriction in Constrictive Pericarditis. Harold A. Lyons, Jesse Minnis, and Edwin Griffin. J. Thoracic Surg. **33**: 305–310, March 1957. (H. A. L.,

State University of New York, College of Medicine at New York City, New York, N. Y.)

A case of superior vena cava constriction related to constrictive pericarditis, which was diagnosed preoperatively by angiocardiography, is reported. This is the first instance of preoperative recognition of the condition. Such demonstration is important since it enables the surgeon to plan the extent of his decortication. Should the pericardectomy be inadequate and this type of defect remain uncorrected, best results might not be obtained.

Interestingly, in the case reported heart catheterization pressure studies did not support the diagnosis of such an obstruction, but the condition was confirmed at surgery. The authors feel that this indicates the need for angiocardiography routinely as a preoperative study in all cases of constrictive pericarditis.

Four roentgenograms; 1 diagram; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Intrapericardial Interatrial Teratoma (Bronchogenic Cyst): Report of a Case Correctly Diagnosed and Successfully Removed. C. Harwell Dabbs, E. Converse Peirce, II, and Freeman L. Rawson. New England J. Med. **256:** 541–546, March 21, 1957. (Acuff Clinic, Knoxville, Tenn.)

The authors report the successful diagnosis and removal of a large intrapericardial interatrial cystic tumor that caused no symptomatology but did distort the cardiac anatomy. Routine films on a twenty-year-old woman showed an unusual fullness along the right superior border of the heart. Angiocardiography demonstrated a large filling defect in the cardiac silhouette, with marked distortion of the heart and displacement of the superior vena cava, right atrium and ventricle, and left cardiac border. The findings were interpreted as indicating a tumor, presumably, because of its size and the absence of symptoms, benign. Intrapericardial teratoma was considered the most likely diagnosis. This was confirmed at operation.

This type of tumor, though commonly known as teratoma, is probably a bronchogenic cyst. In early embryologic development there is an opening between the pleuropericardial folds. The proximity of the heart and lung buds at this stage renders it quite possible that a rest from the lung bud could be incorporated in the pericardium, which later closes.

Seven roentgenograms; 1 photomicrograph; 4 photographs; 1 diagram. PAUL MASSIK, M.D.
Quincy, Mass.

Congenital, Multiple Peripheral Stenoses of the Pulmonary Artery. Å. Gyllenswärd, H. Lodin, Å. Lundberg, and T. Möller. Pediatrics **19:** 399–410, March 1957. (A. G., Children's Clinic, University of Uppsala, Uppsala, Sweden)

With the advent of cardiac catheterization and selective angiocardiography an unsuspected development has been the demonstration of aplasia, stenosis, and other abnormalities of the main trunk of the pulmonary artery and of its branches. The authors present 8 cases of stenosis of the pulmonary vasculature discovered by this means in the various childrens' clinics in Stockholm.

Two main types of this anomaly are encountered. In the first there are a short membranous stenosis about 1 cm. distal to the pulmonary valve, with elongated mild stenosis in one of the main branches of the artery. This type was represented by a single case in the authors' series. The remaining cases were of the second type, consisting of multiple short or long bilateral constrictions extending from the main artery to relatively fine extrahilar branches.

Clinically the children with multiple stenoses are usually underdeveloped and have significant diminution of physical tolerance. In the event of an associated patent foramen ovale with high pressure in the right ventricle due to the stenosis, cyanosis becomes evident. But even in the absence of associated cardiac defects, cyanosis will appear on exertion due to the decrease in cardiac output. Clubbing and polycythemia are absent.

On physical examination the most consistent finding is a loud, protracted systolic murmur over the pulmonary area, becoming continuous over some sites. The continuous phase of the murmur is probably due to the uninterrupted flow through the peripheral stenotic segments during diastole. The electrocardiogram shows varying degrees of right ventricular dominance depending on the extent of the constriction in the pulmonary artery.

On routine chest films there is prominence of the right ventricle, with or without cardiomegaly (due to enlargement of the right atrium and ventricle). In most instances the vascularity of the pulmonary fields is diminished. In the presence of indistinct, small hilar pulmonary arteries, with prominence of the more peripheral portions, stenosis may be strongly suspected. The diagnosis rests, however, upon demonstration of narrowed portions of the pulmonary trunks by selective angiocardiography with the tip of the catheter in the proximal pulmonary trunk. Where the status of the pulmonary valve is also in doubt, it may be fruitful to inject the medium directly into the right ventricle.

In cases of a single membranous stenosis distal to the pulmonary valve, surgical intervention is rewarding. In the usual type, where multiple, bilateral segments of varying lengths of narrowing prevail, surgery is contraindicated. Blind endings, unlike aneurysmal dilatations, are also encountered in the latter group.

Eight roentgenograms; 3 cardiograms; 1 diagram.

SAUL SCHEFF, M.D.
Boston, Mass.

An Apparatus for Extended Aortography and Femoral Arteriography. Specifications and Roentgen Technique. John William Fries and Falls B. Hershey. Arch. Surg. **74:** 394–398, March 1957. (St. Anthony's Hospital, 3520 Chippewa St., St. Louis, Mo.)

An apparatus is described which will allow successive filmings of a 36-inch length of the trunk and legs following translumbar injection of contrast material into the aorta. Briefly, the apparatus consists of a specially made elongated box accommodating a special cassette (37 3/16 × 15 3/16 inches overall) and film in a tunnel. In grooves above the film travel a 15 × 18-inch wafer grid and a sheet of lead 2 mm. thick. These two parts are interconnected so that, while the grid is in position over one-half of the film, the other half is protected by the lead sheet. By movement of a handle, the positions of the grid and protective lead sheet can be quickly interchanged so that the unexposed half of the film can subsequently be exposed at predetermined inter-

val and exposure factors. With this device it is possible to obtain good quality films of a long segment of the injected vascular tree at favorable time intervals and exposure factors.

Specifications of the apparatus are given in reasonable detail and should be consulted by those interested. The equipment will be commercially available.

Suggested radiographic factors are presented. The single x-ray tube is placed at a long focal skin distance to allow complete coverage of the special long film without necessity of changing the tube position during the procedure.

[No consideration is given to the radiation exposures to operating personnel or the patient.—J. W. B.]

Two drawings; 1 table. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Lobus Venae Azygos and the Roentgen Visualization of the Azygos Vein. H. J. Süsse and R. Julitz. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 310–315, March 1957. (In German) (Universitäts-Röntgeninstitut, Leipzig C1, Germany)

Ordinarily in the embryo the arch of the vena azygos runs in the tracheobronchial angle. It may, however, run too far laterally, in which event it will, during subsequent development, cut a wedge-shaped piece out of the upper lobe of the lung, and lobus venae azygos will result. Usually this occurs on the right side, but it may also occur on the left or bilaterally. As the arch originally develops extrapleurally, the septum, which usually appears as a hairline on the postero-anterior chest film, consists of four leaves, the two outer leaves of parietal pleura and the two inner leaves of visceral pleura. At the bottom of the hairline, usually at the level of the 3rd or 4th rib, is the well known droplet-like shadow which represents the axially projected vena azygos. Ordinarily the vein is much lower.

The author has demonstrated the vena azygos in normal patients and in patients with lobus venae azygos by means of transosseous injection of opaque material (injection into the bone marrow of a rib). The abnormal course of the vein can be plainly demonstrated. The visualization of the vein and the clarification of its anatomical relationship may be of importance if atelectasis, retrosternal struma, pneumonic or tuberculous infiltrations, etc., in this area are to be clinically evaluated.

The technic of transosseous venography was described in a previous article (Süsse, H. J.: Fortschr. a. d. Geb. d. Röntgenstrahlen **85:** 181, 1956. Abst. in Radiology **68:** 906, 1957).

Nine roentgenograms; 2 diagrams.
WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Intra-Osseous Venography with Special Reference to Its Complications. Jack Lester and Carl E. Lampe. Brit. J. Radiol. **30:** 145–147, March 1957. (Copenhagen County Hospital, Gentofte, Denmark)

The authors describe their experience with intra-osseous venography, with special reference to the complications, which were of higher frequency than has been reported by others. They have performed intra-osseous venography on 13 patients, in 1 case on both sides. The series included 6 females and 7 males, ranging from twenty-four to fifty-three years of age. All the patients had varicose veins, and most of them had previously had phlebitis with complications. All were subjected to repeated examinations, including roentgenograms at the site of injection.

Complications consisted mostly of local reactions. Considerable subcutaneous leakage of contrast medium was found in only 1 case, due to faulty technic. All the patients complained of pain after the injection. In about half of the cases this was mild and of short duration (less than one week); in 2 cases it persisted for more than a month. An elevation of temperature occurred in 4 patients. Thrombophlebitis developed in 2 instances. Delayed hemorrhage occurred in 1 case where there were no other complications.

The observations were carried out for periods of from three to thirteen months. The 2 patients with thrombophlebitis still revealed slight tenderness at the site of injection six months after venography. The others had no sequelae which could be attributed to the procedure.

The authors conclude that the method is indicated only in special cases, since complications are apt to occur. Its use is recommended when the following requirements are fulfilled: (1) percutaneous injection is impossible owing to the absence of suitable veins; (2) the examination is performed by an experienced administrator; (3) the concentration of the contrast medium does not exceed 35 per cent; (4) the injection needle is firmly held in place by the cortex throughout the injection. THEODORE E. KEATS, M.D.
University of Missouri

Spontaneous Rupture of a Major Renal Artery Diagnosed by Translumbar Aortography. W. F. Melick and J. J. Naryka. Missouri Med. **54:** 242–243, March 1957. (539 N. Grand Ave., St. Louis, Mo.)

A case believed to represent spontaneous rupture of a renal artery in a 28-year-old white man is reported. Preoperative roentgenograms showed a mass in the region of the right kidney and translumbar serial aortograms revealed a definite leak of contrast medium into the mass. A right nephrectomy was done and a large encapsulated mass adherent to the kidney was removed with it. The operative specimen was immediately perfused through the renal artery with catheters tied into the renal veins, and the picture that had appeared on the serial aortograms was again obtained. Careful pathologic study of the removed kidney showed no evidence of arterial disease or aneurysm. There was no history of trauma.

Four roentgenograms; 2 photographs.

Roentgen Visualization of the Hepatic Veins. H. R. Ney. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 302–309, March 1957. (In German) (Röntgeninstitut der Städtischen Krankenanstalten, Ulm/Donau, Germany)

Visualization of the portal vein and its ramifications is a well known and standardized procedure, but the hepatic veins which carry the blood from the liver into the vena cava have become a subject of intense radiological study only in recent years. The author's technic for demonstration of these veins is as follows: Under local anesthesia a Cournand catheter No. 8 or 9 is inserted into the cubital vein, pushed upward under fluoroscopic control until it reaches the right atrium of the heart, and, at this point, twisted so that the tip points backward to permit its introduction into the inferior vena cava. The catheter is then further advanced until it has surely passed the hepatic veins. It is now twisted until the tip points toward the right and

then is slowly pulled back. When it reaches the right hepatic vein (close below the diaphragm), the tip hooks itself into the vessel with a slight jerk. The catheter is then advanced again, and its deviation to the right, as seen fluoroscopically, is an indication that it is in the right hepatic vein. Following a further advance into the inner structures of the liver and rapid injection of 5 c.c. of 70 per cent Joduron, a film may be obtained which shows the finer ramifications of the veins. By withdrawing the catheter a little and injecting a larger amount of the medium (15 to 18 c.c.), a more transient but quite contrasty filling of the larger branches and ramifications may be obtained. If the injection is made with too much pressure, the Joduron will enter the sinusoids and rather diffuse patches of contrast material without much structure will be obtained.

The author has subjected 16 patients to this type of examination. He has often noticed thin communicating vessels between the hepatic veins and other circulating systems of the liver, which he considers to be the portal system (not the arterial system). However, these anastomoses have never been found in cirrhosis of the liver. It was observed further that, in cirrhosis, the lumen of the veins is considerably contracted but that the velocity of the blood flow is markedly increased. Tumors of the liver may produce displacement and distortion of the normal tree-like ramifications of the hepatic veins.

Seven roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Adductor-Canal Thrombosis. George R. Dunlop and Rodriguez Santos. New England J. Med. **256:** 577–580, March 28, 1957. (G. R. D., Tufts University School of Medicine, Boston, Mass.)

The authors are convinced that the most common cause of peripheral ischemia of the lower extremity is thrombosis in the adductor canal. Further, they feel that the inciting agent in the development of the thrombosis is a localized trauma by the adductor tendons and fascia with immobilization and constriction of the underlying vessel. Their clinical and surgical experience strongly suggests that relief of vessel fixation will frequently produce clinical improvement even if continuity of the narrowed or thrombosed vessel is not restored.

A series of 7 patients judged ineligible for resection of the involved vessel with grafting have been treated by unroofing of the adductor canal and mobilization of the artery with subsequent subjective and objective improvement. Results have been particularly gratifying in patients with incomplete obstructions. Mobilization of the trapped vessel will tend to interrupt an otherwise progressive narrowing and thrombosis.

Patients who demonstrate thrombosis of one adductor canal will frequently show a similar but less advanced process in the other thigh, so that all such patients should have bilateral investigations.

The mainstay in the clinical work-up of these cases is the femoral arteriogram. The authors' technic is described. In summary, all patients receive general or spinal anesthesia, and a direct surgical exposure of the superficial femoral artery is effected. The artery is then cannulated through its anterior surface with plastic tubing introduced through a puncture needle, and 20 c.c. of 50 per cent Hypaque is injected. Anteroposterior views of the entire leg are made on two adjacent 14 × 17-inch films, at a long target-film distance. As noted above, both legs are investigated because of the high likelihood of lesser degrees of involvement on the apparently normal side.

Two arteriograms; 2 photographs.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Considerations in the Accuracy of Arteriography. Otto Trippel, Victor Bernhard, Robert Hohf, and Harold Laufman. Surgery **41:** 153–163, January 1957. (Northwestern University Medical School, Chicago, Ill.)

Although arteriography is a well established procedure, it is not entirely without hazard, and numerous complications may occur. The authors believe that more careful consideration of the indications and contraindications for arteriography, more meticulous attention to certain technical details, and a full realization of the responsibilities will lessen the dangers and at the same time endow the procedure with even more significance than it possesses today.

Four roentgenograms; 3 photographs.

THE DIGESTIVE SYSTEM

Intramural Duplication of the Esophagus. Herbert C. Maier. Ann. Surg. **145:** 395–403, March 1957. (Lenox Hill Hospital, New York, N. Y.)

The case history of a woman in whom dysphagia developed late in the fifth decade of life is presented in detail. Barium studies demonstrated a marked narrowing of the esophagus beginning at the thoracic inlet and extending caudad for more than six vertebral segments. Endoscopy revealed a web-like structure at the proximal end of the narrowed segment. A week later a repeat examination with barium showed a long channel paralleling the esophagus and terminating blindly. Swallowing caused the barium from this pouch to flow upward and into the continuous esophageal lumen, indicating an intraluminal location. Operation was undertaken. The esophagus was opened and found to contain a double channel starting at the level of the second thoracic vertebra and extending downward to about 4 cm. caudad to the vena azygos.

In the differential diagnosis it should be noted that a short duplication which has a single communication with the main esophageal lumen at its oral end is likely to simulate a diverticulum. A diverticulum, however, is more likely to be rounded, to be extraluminal in location, to have a neck, and to empty by gravity in contrast to the tubular configuration of duplication with muscular emptying of its contents.

A brief review of the literature on esophageal and intestinal duplication is presented.

Four roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

The Roentgen Examination of the Gastrointestinal Tract in the Newborn, with Particular Reference to Examination Without the Use of an Oral Contrast Medium. H. G. Wolf. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 323–334, March 1957. (In German) (Universitäts-Kinderklinik in Wien, Vienna, Austria)

The author believes that the x-ray examination of the newborn for obstructive lesions of the gastrointestinal tract can and should be done without the use of orally administered contrast media. Anteroposterior and lateral views of the trunk routinely taken in the upright

position will almost always permit a correct diagnosis from observation of the gas shadows alone. The only exception to this rule is the oral use of Ioduron (not barium!) for the demonstration of congenital obstructive lesions of the esophagus. The barium enema is harmless and quite helpful for the lesions in the lower bowel.

Plain films of the normal newborn infant at one, two, three and five hours after birth are reproduced, showing how the air gradually progresses through the intestinal tract until it reaches the rectum (about five hours after birth). Other films are illustrative of diaphragmatic hernia; atresia and stenosis of the esophagus, the duodenum, the midjejunum and the rectum; meconium ileus and congenital megacolon. In the last two cases, a radiopaque enema was helpful. Meconium ileus can often be recognized by the intimate mixture of some gas with the meconium, which gives the obstructing plug a somewhat granular appearance.

The roentgenograms are excellent. In a series of 54 cases, there were 38 atresias and stenoses (mostly esophagus and rectum), 6 cases of megacolon, 7 of meconium ileus, and 3 of malrotations.

Twenty-three roentgenograms; 1 table.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

The Roentgen Appearance of Mucosal Folds in Chronic Gastritis Proved by Biopsy. R. Cheli and L. Oliva. Radiol. med., Milan **43:** 226–237, March 1957. (In Italian) (Università di Genova, Genova, Italy)

This study is based on 108 cases of chronic gastritis (54 superficial, 10 interstitial, 14 pre-atrophic, 24 atrophic, and 6 postoperative), evaluated both by gastric biopsy (*via* esophagogastric intubation) and by routine barium meal. In addition, 15 healthy controls were examined for comparison. The authors conclude that all the findings described in the literature (folds which are polypoid, tortuous, hypertrophic, or thin, an areolar appearance of the fundal area, etc.) can be found in healthy people as well as in patients with gastritis and are therefore of little help in roentgenologic differentiation. There was likewise no evidence of statistical correlation between any finding, or group of findings, and a given type of gastritis.

Thirteen roentgenograms; 9 photomicrographs; 10 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital

A Study of Motility in the Gastric Remnant Following Subtotal Gastrectomy. George L. Jordan, Jr., Harry L. Barton, and Willie A. Williamson. Surg., Gynec. & Obst. **104:** 257–262, March 1957. (Baylor University College of Medicine, Houston, Texas)

The authors undertook to elucidate the degree and significance of motility in the gastric remnant in the early period following gastrectomy and to evaluate its role in the syndrome of postoperative retention. Forty-six patients were studied between the ninth and fifteenth postoperative days roentgenologically and/or by measurements of intraluminal pressure. Roentgenographic studies of the barium-filled remnant were made in 42 patients at 1, 3, 5, 7, 9, 10, 30, 60, 120, and 180 minutes in the erect position; in 10 cases the examination was repeated in the Trendelenburg position.

Both types of examination revealed minimal peristaltic activity in the gastric remnant. The normal tone of the gastric wall, jejunal peristalsis, changes in intra-abdominal pressure, diaphragmatic motion, and gravity appeared to be the important factors in emptying. Gastric atony, therefore, cannot be considered to play a primary role in postoperative retention.

Gastric emptying time was more rapid in cases following gastrojejunostomy than after gastroduodenostomy. Emptying time was prolonged in the Trendelenburg position. None of the patients complained of postgastrectomy symptoms at the time of these studies and it was felt that the apparent speed with which the gastric remnant empties is not the most important factor in development of postgastrectomy syndrome and that diagnosis of "postgastrectomy syndrome" cannot be made roentgenologically.

Two patients who required re-operation were found to have efferent loop obstruction due to adhesions, and in 2 others obstruction in the efferent loop was demonstrated roentgenologically. Such obstruction, the authors believe, is the most common cause of gastric retention following gastrectomy.

Four roentgenograms; 3 motility tracings.

DECK E. CHANDLER, M.D.
University of Pennsylvania

Peptic Ulcer Near the Pylorus. William T. Foulk, Mandred W. Comfort, Hugh R. Butt, Malcolm B. Dockerty, and Harry M. Weber. Gastroenterology **32:** 395–403, March 1957. (Mayo Clinic, Rochester, Minn.)

The region of the stomach just above the pyloric sphincter is sometimes called the pyloric channel. Its proximal boundary is indefinite, but can be usefully defined as lying 2 cm. from the gastroduodenal junction.

Peptic ulcers occurring within the pyloric channel have been said to present a somewhat specific clinical picture, distinguishing them from peptic ulcers elsewhere in the upper gastrointestinal tract. In an attempt to verify this impression, 83 cases of active benign ulcer near the pylorus were reviewed, with special attention to history, x-ray findings, and pathological findings.

From the survey the authors formed the opinion that benign ulcers near the pylorus are not sufficiently specific clinically to permit differentiation from other upper gastrointestinal tract ulcers. They also point out the frequent inaccuracy of roentgen localization of ulcers near the pylorus.

A definite statement by the roentgenologist as to the gastric or duodenal location of an ulcer near the pylorus can be very helpful. The designation "prepyloric ulcer" carries with it connotations of malignancy, and its use in pyloroduodenal and duodenal ulcers is undesirable. Use of the designation "ulcer at or near the pylorus" is suggested.

Six tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Chronic Duodenal Ileus Due to Chronic Arteriomesenteric Occlusion. Report of a Case. J. L. Lu and G. M. Cole. Arch. Surg. **73:** 1022–1025, December 1956. (201 W. 10th St., Dallas, Texas)

Chronic duodenal ileus due to chronic arteriomesenteric occlusion is a rare condition. Any factor which lessens the angle between the superior mesenteric artery and the aorta and/or any undue traction on the mesentery will tend toward duodenal occlusion.

The authors report a case and discuss the classifica-

tion, radiological findings, and treatment of this condition. Chronic duodenal ileus is of two types: (1) nonobstructive, consisting primarily of dilatation of the duodenum without organic obstruction; (2) obstructive, due to intrinsic or extrinsic causes, of which chronic arteriomesenteric occlusion is the most frequent.

Typical roentgen signs are dilatation of the duodenum, and persistence of the valvulae conniventes which are thinned as a result of stretching of the mucosa between the valvulae. Duodenal peristalsis is active and often there is a "to-and-fro" movement characteristic of duodenal obstruction. The bowel is flattened against the spine, its lumen often being reduced to a vertical slit.

An established case of chronic duodenal ileus by chronic arteriomesenteric occlusion should be managed by medical treatment first. Surgical management depends primarily on the etiology.

Three roentgenograms.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Post-Gastrectomy Bilious Vomiting Investigated with Biligrafin. John E. S. Scott and C. G. Whiteside. Lancet **2:** 1330–1332, Dec. 29, 1956. (C. G. W., Middlesex Hospital, London, England)

The behavior of the afferent loop was studied in 6 patients who had had a satisfactory Polya-type gastrectomy and in 5 who had had a similar operation but complained of epigastric discomfort which came on shortly after a meal and was relieved by vomiting bile unmixed with food. The patient was not specially prepared for the examination. Biligrafin Forte, 20 ml., was injected intravenously, and for two hours no food or drink was allowed. With the patient supine, roentgenograms were taken at 30, 60, 90, and 120 minutes after the injection, using 15 × 12-inch films so that the contrast medium in the biliary and upper intestinal tracts could be visualized. The patient was then given a meal, and further exposures were made thirty and sixty minutes later.

In all 5 patients with postcibal bilious vomiting, the gallbladder became very distended but contracted normally after a meal. This was completely unexpected. In 4 of the 5 patients no contrast material was seen flowing through the afferent loop before the gallbladder began to contract. Neither the common bile duct nor the afferent loop was dilated.

While the authors make no attempt to explain these findings, they suggest that the operation may have caused some functional abnormality in reflex activity of the gallbladder. The relationship between the abnormality in biliary flow and the bilious vomiting is also difficult to determine. It seems as though the bile is prevented from entering the duodenum in a continuous stream either by spasm of the sphincter of Oddi or by loss of tone in the gallbladder. The bile collects in the gallbladder, overdistending it until a meal is taken, which stimulates the gallbladder to contract powerfully and rapidly eject its contents into the afferent loop. This sudden flow of bile may enter the gastric stump and be vomited.

Five roentgenograms.

In a Letter to the Editor, in the Feb. 9, 1957, issue of *Lancet*, Drs. W. M. Capper and G. R. Airth comment on the article by Scott and Whiteside. They have used intravenous cholangiography to demonstrate the afferent loop in over 50 cases. They believe the afferent loop is shown best, whether stasis is present or not, before the gallbladder is caused to contract. A roentgenogram is taken two hours after injection of Biligrafin and while the patient is still fasting. After food has been taken and the gallbladder has contracted, the fine contrast pattern of the normal afferent loop is lost. These workers believe, also, that the roentgenograms should be taken with the patient erect, as the effects of afferent-loop stasis are demonstrated to the best advantage in this position. The afferent loop tends to empty (in the absence of physical obstruction) in the supine position. Their observations indicate that distention of the gallbladder is not a factor in bilious vomiting. In their experience the afferent loop in these cases is usually normal. Why the biliary fluid is held up in the gastric remnant in some instances and not in others remains an unsolved problem.

Arteriomesenteric Duodenal Stenosis. E. Kopp and J. M. Bivetti. Schweiz. med. Wchnschr. **87:** 230–231, March 9, 1957. (In German) (Universität Zürich, Zürich, Switzerland)

Three cases of duodenal stenosis due to arteriomesenteric compression are discussed in detail. The authors stress the importance of conducting the x-ray examination in the upright position. The stenosis is usually seen in the middle third of the pars caudalis duodeni. If the examination is done only in the recumbent position, the changes can often not be recognized, since barium passes without hindrance. The clinical picture, as well as possible factors causing arteriomesenteric duodenal stenosis, and therapy are discussed.

Four roentgenograms. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Retrograde Jejunogastric Intussusception—A Rare Cause of Hematemesis. Review of the Literature and Report of Two Cases. Dale G. Foster. Arch. Surg. **73:** 1009–1017, December 1956. (Sakbayeme, French Cameroun, West Africa)

Retrograde jejunogastric intussusception is one of the rarest causes for hematemesis. If misdiagnosed, it has a 100 per cent mortality. In nearly 30 per cent of the reported cases, the diagnosis was not made until autopsy. The author reviews the literature and reports 2 cases.

The incidence is definitely higher in women than in men, a fact which is significant when it is remembered that the incidence of gastric surgery for ulcer is much higher in men, as is also the incidence of other types of intussusception of the gastrointestinal tract. The diagnosis should be seriously considered in cases of massive upper gastrointestinal bleeding following gastric surgery, with or without pain, with or without a palpable mass, and almost certainly if both pain and a mass are present.

Of 70 cases reported up to 1948, only 12 were diagnosed roentgenologically. The following are characteristic roentgen signs: (1) the presence within the lumen of the stomach of a partially movable filling defect with parallel curved lines simulating a normal small bowel pattern; (2) the re-entry into the stomach, by way of the afferent loop and stoma, of some of the barium which has previously left the stomach through the pylorus; (3) delayed gastric emptying.

When proper treatment is instituted, *i.e.*, immediate

surgery, success may be expected in 90 per cent of the cases.

Four figures. ROBERT H. LEAMING, M.D.
Memorial Center, New York

Hirschsprung's Disease in the Neonatal Period. A Report of Five Cases, Four of Which Involved the Small Intestine. D. H. Bowden, A. M. Goodfellow, and J. D. Munn. J. Pediat. **50:** 321–326, March 1957. (D. H. B., Cardinal Glennon Children's Hospital, St. Louis, Mo.)

In the two years prior to the publication of this paper the authors saw 5 fatal cases of Hirschsprung's disease in which symptoms appeared in the neonatal period. Four of these cases showed ganglion aplasia of the entire large bowel and a portion of the small bowel. The authors believe that the paucity of reports of long-segment Hirschsprung's disease in the literature reflects a lack of awareness of the condition and suggests that these cases have usually been misdiagnosed.

The 5 cases reported here illustrate the difficulties of diagnosis. The presenting symptoms were vomiting and abdominal distention, meconium stools were usually passed, and 1 infant had an episode of diarrhea. The x-ray picture was equally confusing, many of the roentgenographic signs suggesting meconium ileus or ileal atresia. Scout films of the abdomen showed evidence of acute small bowel obstruction; in 2 cases pneumoperitoneum was demonstrable. The presence of gas in the rectum in 3 cases probably contradicted the diagnosis of meconium ileus and certainly excluded atresia of the ileum. Peritoneal calcification in 1 case was thought to indicate antepartum perforation of the intestine consequent on meconium ileus, although no evidence of perforation was found at autopsy.

Barium enema studies in 3 of 5 cases revealed that the colon was smaller than normal. In 1 case, however, the colon appeared to be of normal caliber and tone although the whole of the large intestine was aganglionic.

The authors conclude that the only radiological signs of value in the diagnosis of Hirschsprung's disease in the neonatal period are pneumoperitoneum, microcolon with gas in the rectum, small bowel obstruction, and calcification in the abdomen. It is often difficult to determine in a single roentgenogram whether there is any narrowing of the large intestine, and a barium enema study should therefore be carried out in all suspected cases.

Removal of the whole aganglionic segment of bowel is the only rational treatment of Hirschsprung's disease. When the segment extends into the small intestine, the difficulties are obvious. It may be possible, however, as Sandegaard has shown (Acta chir. scandinav. **106:** 369, 1953), to save some of these patients.

Five roentgenograms; 1 table.

Ano-Rectal Atresia with a Loop of Dilated Small Bowel Simulating Rectum. A. F. Bryson and J. C. Chartres. Brit. J. Radiol. **30:** 99–101, February 1957. (City Hospital, Kano, Northern Nigeria, Nigeria)

This report draws attention to the frequent (15 to 18 per cent) association of anorectal atresia (including imperforate anus) with multiple atresia elsewhere in the bowel. Small bowel atresia, when viewed radiographically in the inverted position, may so closely simulate rectal dilatation that, when anorectal atresia is coexistent, the radiologist is prone to accept this latter condition as the sole lesion.

The authors cite an example of the above situation occurring in a three-day-old infant, in whom the anorectal atresia was relieved by simple puncture with a tenotomy knife, only to have death result a few hours later from a coexistent ileal obstruction. For comparison, an uncomplicated instance of imperforate anus, also in a three-day-old infant, is cited.

The authors mention several diagnostic aids. Clinically the history of early vomiting in a case of anorectal atresia will suggest the probability of obstruction at a higher level. The true rectal gas shadow conforms to the V-shaped pelvic floor, while the false "rectal" shadow is more rounded inferiorly. With the infant in the inverted position, the presence of a persistent fluid-gas interface is evidence of true rectal gas and fluid, while small bowel fluid is more apt to gravitate in a cephalad direction. Absence of the fluid-gas interface does not, however, indicate that the gas-filled bowel is not the rectum.

Six roentgenograms. R. E. GINTER, M.D.
Indiana University Medical Center

Pancreatography—Indications and Observations. Henry Doubilet, Maxwell H. Poppel, and John H. Mulholland. J.A.M.A. **163:** 1027–1030, March 23, 1957. (H. D., 550 First Ave., New York 16, N. Y.)

The authors have described elsewhere their technic for roentgen demonstration of the pancreas (Radiology **64:** 325, 1955). It consists in transduodenal section of the sphincter of Oddi and insertion of a fine plastic tube for a distance of 4 to 5 cm. into the pancreatic duct. A radiopaque solution (Urokon) is injected slowly over a period of five minutes. A total of 10 c.c. is usually used, the last 2 c.c. being injected during the exposure.

Pancreatography is of value in the study of severa conditions. Determination of an acute inflammatory process is possible, since under these circumstances only the main ducts will be demonstrated on the pancreatogram. The whole pancreas may be opacified deliberately if one is searching for a tumor such as an adenoma. The dilated ducts of a chronic pancreatitis will be readily visualized. This type of examination may also be of value in discovering cysts, cystic dilatations, and pseudocysts. Patency of the main pancreatic duct may be demonstrated. When the main duct is obstructed near its distal end, the opaque medium may be injected into the accessory pancreatic duct and throughout the duct system of the pancreas, perhaps revealing the site of obstruction in the main duct. If a cyst is present in the pancreas, the absence of a connection between the main duct and cyst may be shown.

Nine roentgenograms; 1 diagram.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

A Method for the Visualization of the Configuration and Structure of the Liver. Part A. Preliminary Clinical Investigations. H. L. Friedell, W. J. MacIntyre, and A. M. Rejali. Am. J. Roentgenol. **77:** 455–470, March 1957. (H. L. F., University Hospitals of Cleveland, 2065 Adelbert Road, Cleveland 6, Ohio)

Part B. A Counting Rate Cut-Off Circuit for Increased Contrast in Automatic Scanning. W. J. MacIntyre and T. S. Houser. Am. J. Roentgenol. **77:** 471–475, March 1957. (W. J. MacI., Department of Radiology, Western Reserve University, Cleveland, Ohio)

Friedell and his associates use an automatic scanning

scintillation counter to map out the configuration of normal and abnormal livers. A special cut-off circuit accentuates differences in the counting rate. The resultant hepatoscans have been useful in demonstrating liver enlargement, changes in configuration due to pressure or encroachment, and space-occupying defects within the liver. Three isotope preparations were found to give the best results: radioactive tetraiodophenolphthalein (I^{131}), radioactive rose bengal (I^{131}), and radioactive colloidal gold (Au^{198}). Of these, the authors favor rose bengal. Its biologic half-life is shorter than that of tetraiodophenolphthalein, its uptake by the polygonal cells of the liver is more rapid, and about 50 per cent or more disappears from the blood within eight minutes following injection. Also, the dosage required for good visualization is low. It delivers a dose of about 0.5 rep compared with 8 rep for Au^{198} and 7.5 rep for tetraiodophenolphthalein.

After the isotope is injected intravenously, the count is taken when maximum concentration is present in the liver. (This interval varies depending on the material used.) The counting takes about one-half hour and the depiction depends on the radioactivity in the normal liver. There is no way to determine what causes any given defect within the pattern of the hepatoscan. Phantom studies by the authors indicate that the minimal size of a defect that this method will detect is about 2.5 cm. diameter on the right side and about 1.5 cm. diameter on the left.

MacIntyre and Houser describe the details of the cut-off circuit which increases the contrast of the counting rate.

Eighteen figures. D. D. ROSENFELD, M.D.
Fontana, Calif.

Hepatography with Radioactive Gold. H. R. Renfer, G. G. Poretti, C. Massini, and A. Zuppinger. Schweiz. med. Wchnschr. **87:** 255–259, March 16, 1957. (In German) (Röntgeninstitut der Universität Bern, Bern, Switzerland)

The authors describe their experience with a fully automatic scintiscanner for liver scanning, using radioactive gold: 500 μc of Au^{198} are given intravenously two hours before the examination, and of this 75 to 85 per cent is stored in the reticuloendothelial system of the liver.

The level of the diaphragm in inspiration and expiration is determined fluoroscopically and is recorded on paper together with the xiphoid process and the rib margins. An abdominal binder is used to decrease liver excursion from respiration. The collimator opening is 9 mm. and the motion is 2 mm. per second. This gives about ten to twelve registrations in zones of greatest activity. The total time for scanning of the upper abdomen is between an hour and a half and two hours. In a normal hepatogram, the radioactive gold is evenly distributed throughout the liver, except for the hilus region.

The authors used a liver-phantom to test the resolution power of Au^{198} in the liver. Lesions 5 cm. in diameter could be demonstrated anywhere in the liver; lesions of 3 cm. did not always register; superficial lesions of 2 cm. in diameter could be detected. The use of so large a dose as 500 μc appears justified since smaller doses do not give uniform results, particularly with a decrease of reticuloendothelial cells in the liver, as in diffuse liver disease, when more gold is stored in the spleen and bone marrow.

The authors have used their method for diagnosis of liver metastases, liver abscesses, echinococcus cysts, and subphrenic abscesses, and in the differentiation of right upper quadrant masses.

Ten figures. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Cholecystitis Glandularis Proliferans. L. P. Le Quesne and I. Ranger. Brit. J. Surg. **44:** 447–458, March 1957. (Middlesex Hospital, London, England)

Cholecystitis glandularis proliferans is characterized by (1) epithelial sinuses (Rokitansky-Aschoff) which penetrate the muscularis of the gallbladder to expand in the subserous layer with the formation of cyst-like spaces, (2) localized hypertrophy of the muscle coat, and (3) chronic inflammatory changes.

Twelve histologically proved cases are reported, 4 asymptomatic cases found at autopsy and 8 with symptoms of chronic gallbladder disease demonstrated by cholecystography. Cholecystograms showed one or more of the following characteristic signs: (1) a fundal filling defect, sometimes with a central pit, (2) a stricture of the gallbladder, (3) contrast-filled spaces around the periphery of part of the gallbladder shadow ("diverticulosis"). The sinuses show more clearly after feeding in some cases. Five of the patients also had gallstones. The fundal filling defect was due to a localized area of sinus formation and muscular hypertrophy which in the past has sometimes been reported as a papilloma or adenomyoma.

The authors feel that, at least in the early stages, the disease is distinct from chronic cholecystitis because part of the gallbladder is normal. In view of the nature and distribution of the lesions, it is suggested that the condition results from some disturbance in the normal contraction of the gallbladder. The results of cholecystectomy are as good as in cholelithiasis.

Eleven roentgenograms; 4 photomicrographs; 6 photographs, including 4 in color; 3 drawings and charts. CAPT. GARTH R. DREWRY
MacDill AFB, Fla.

A Report on a Clinical Trial of a New Opaque Medium for Cholecystography. J. J. Geere and B. T. Hooper. South African M. J. **31:** 229–230, March 9, 1957. (Port Elizabeth, Union of South Africa)

A new opaque medium, phenobutiodil or Biliodyl, was used in an unselected group of 50 patients referred for cholecystography. The compound was originally known as 4114 T. H. and chemically is 1-(2 : 4 : 6-Triiodophenoxy) butyric acid.

Concentration was classified as excellent in 27 of the 50 cases, good in 17, poor in 3, and nil in 3. Of the 44 cases showing excellent or good concentration, 39 had normal gallbladders, and in no case was concentration so dense that one felt in danger of missing a small nonopaque calculus. In the 6 cases with poor or no concentration, repeat examinations were carried out with Teridax (triiodoethionic acid), and in 4 of these visualization was again classified as poor or nonexistent.

Side-effects included 4 cases of mild or moderate nausea (in no case with vomiting), and 2 of mild or moderate diarrhea. The patient who complained most of nausea had a gallbladder full of nonopaque calculi.

In very few cases was there any appreciable trace of the medium visible in the bowel fourteen hours after administration of the tablets, and in no case was there any interference with visualization of the gallbladder.

The preparation is considered a very satisfactory contrast medium for cholecystography.

THE DIAPHRAGM

Eventration of the Diaphragm. A. Tamas and J. S. Dunbar. J. Canad. A. Radiologists **8:** 1–12, March 1957. (J. S. B., 1615 Cedar Ave., Montreal 25, Canada)

The term eventration of the diaphragm has come to mean elevation of part or all of one leaf of the diaphragm. It may be due to either phrenic nerve palsy or to absence or deficiency of muscle fibers. It is not the result of a dehiscence or an actual defect of the diaphragm.

Four conditions which form a series of related abnormalities are discussed. These are (1) physiologic variations in the normal diaphragmatic contour; (2) diaphragmatic hernia, (3) phrenico-diaphragmatic palsy, (4) eventration of the diaphragm.

Eleven cases of eventration of the diaphragm are presented. In 3 eventration was total. In 2 of these paralytic lesions were associated with facial palsy and hemiplegia respectively.

All but 1 of the 8 cases of partial eventration were asymptomatic. In 3 surgical correction was attempted. Two of the patients were asymptomatic pre- and postoperatively. One had severe cyanosis and dyspnea preoperatively and died postoperatively, autopsy showing a complicating congenital heart lesion of the noncyanotic type which may have contributed to illness and death.

Twenty-six roentgenograms; 2 photographs.

ALVIN S. SEGEL, M.D.
Cleveland City Hospital

THE MUSCULOSKELETAL SYSTEM

Quantitative Roentgenologic Studies on Changes in Mineral Content of Bone in Vivo. Karl-Åke Omnell. Acta radiol. (supp. 148), pp. 1–86, 1957. (Royal Dental School of Malmö, Sweden)

From the Royal Dental School of Malmö, Sweden, comes this report of an investigation many years in the making, with a thorough review and careful appraisal of the attempts of others to measure bone salts *in vivo*. The author outlines the physical problems involved, such as mass absorption coefficients of the tissue elements for ranges of radiation between 15 and 100 kv, the merits of using aluminum wedges for photometric standardizations, the complications of scattered radiation, and the difficulties of duplication and standardization of film-processing technics.

Studies were done on interalveolar bone septa in dogs over a period of several weeks following the insertion of amalgam fillings with overhanging edges in cavities in the proximal surface of the tooth on either side of the bone septum studied, or by burring a defect in the septum. Destruction and repair of bone could thus be followed and periodically measured with aluminum equivalents plotted against time. The methods are beautifully refined and the measurements accurate, probably within 1 per cent. While these elegant refinements could be used in man for studies of osteoporosis and osteomalacia, their real value awaits additional experimentation. For those interested in this subject, Omnell's report will supply a comprehensive background and an insight into the requirements if studies are projected using aluminum wedges for photometric standardization.

Twelve figures; 16 diagrams; 11 tables.

J. GERSHON-COHEN, M.D.
Philadelphia, Penna.

Severe Idiopathic Hypercalcemia of Infancy. George L. Daeschner and C. William Daeschner. Pediatrics **19:** 362–371, March 1957. (G. L. D., Texas Children's Hospital, Houston 25, Texas)

Many instances of mild, transient hypercalcemia in infants have been reported along with the attendant findings: anorexia, vomiting, weight loss, constipation, irritability, and muscular hypertonia. This paper deals with the severe form of the abnormality, reporting an illustrative case in a child followed from seventeen months to death at thirty-two months and reviewing the 15 similar cases previously recorded in the literature. All of the infants showed some degree of dwarfism, malnutrition, mental-motor retardation, and serum calcium elevation (above 11.5 mg./100 ml., with an average high of 15.3 mg. per cent). In all cases where it was determined, the blood urea nitrogen was elevated, and in 6 children urea clearance was impaired.

In the authors' case there was an appreciable increase in density in the base of the skull, calvarium, ribs, and vertebral plates, and bone age was retarded. The lamina dura was absent, the trabecular pattern of bone coarsened. There were alternating stripes of lucency and sclerosis at the ends of the long bones of the extremities. In addition, there was premature synostosis of the sagittal suture and anterior fontanel. Contrast medium injected intravenously for pyelography was poorly concentrated by the kidneys.

In general, the roentgen findings in the cases reported were those of generalized osteosclerosis. Cranial synostosis occurred in 4 patients, and nephrocalcinosis in 2.

The underlying cause of idiopathic hypercalcemia of the milder form has been shown to be a hypersensitivity to vitamin D with excessive calcium absorption. It is also proposed that this is the basic metabolic defect in the severe form of idiopathic hypercalcemia leading to progressive renal failure.

Five roentgenograms; 1 photograph; 6 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Metastatic Adenocarcinoma Simulating a Primary Bone Tumor. A Case Presentation. Frederick W. O'Brien, Jr., and Frederick W. O'Brien. Am. J. Roentgenol. **77:** 452–454, March 1957. (F. W. O., Jr., 465 Beacon St., Boston, Mass.)

Skeletal lesions secondary to primary tumors of the gastrointestinal tract are infrequently observed. The authors present a case of adenocarcinoma of the stomach metastatic to the distal femur.

The patient was a 50-year-old white male with a history of intermittent pain in the right knee for ten weeks, following a "twisting injury" to the knee. Roentgenograms revealed a destructive lesion in the metaphyseal area of the distal right femur, with periosteal elevation, spicule formation, and a Codman's triangle. There was a large posterolateral soft-tissue mass. The roentgen diagnosis was malignant bone tumor, probably osteogenic sarcoma, and supervoltage radiation therapy was instituted, with a tumor dose of 3,500 r delivered in nine days. There were prompt relief of pain and reduction of the soft-tissue mass. Biopsy at this time showed

no tumor cells, but a repeat biopsy revealed a metastatic adenocarcinoma. Multiple examinations failed to disclose the primary site.

Three months later, the patient returned complaining of epigastric distress and chest pain, and a gastric lesion was demonstrated, almost completely replacing the distal two-thirds of the stomach. Chest films revealed a lesion in the left lower lung field. Further treatment was refused and death ensued within three months.

The authors stress the difficulty in arriving at an accurate diagnosis in bone lesions. Full clinical, roentgenologic, and pathologic data must be correlated, contrary to Brailsford's opinion that biopsy is oftentimes unnecessary.

Five roentgenograms.

NORMAN L. ARNETT, M.D.
Upland, Calif.

Medullary Lipoma of Bone. G. Bernard Skinner and Robert G. Fraser. J. Canad. A. Radiologists **8:** 19–21, March 1957. (R. G. F., 687 Pine Ave., Montreal W. 2, Canada)

The authors present a case of benign medullary lipoma occurring in the humerus of a 56-year-old male, bringing the total number of recorded cases to 5. The previously reported lesions have occurred in the femur, the tibia, the fibula, and in the calcaneus, indicating the lack of predilection for any specific bone. The tumors have been found in both sexes of an age group extending from five to fifty-six years.

There exist certain radiological features common to all cases thus far reported which seem to be sufficiently distinctive to enable one to suggest the possibility of this entity in the differential diagnosis of any cystic lesion of long bones: (1) a constant relationship to the medullary portion of the end of a bone; (2) a well corticated margin surrounding the tumor; (3) lack of any tendency toward erosion of the enclosing cortex; (4) absence of any stimulus on the part of tumor to produce subperiosteal new bone; (5) incomplete coarse bony septa dividing the tumor into compartments of varying size.

Confusion has existed in the past between the medullary variety of lipoma and its periosteal counterpart. The distinction lies in the fact that the latter form is intimately associated with the periosteum and exerts its effect on bone by pressure erosion of the cortex from without. An even more common manifestation is its tendency to extend outward and to create a soft-tissue mass, thereby allowing obvious differentiation from the intraosseous variety.

Three roentgenograms.

ALVIN S. SEGEL, M.D.
Cleveland City Hospital

Paget's Disease—Active or Quiescent? Ronald G. Grainger and John W. Laws. Brit. J. Radiol. **30:** 120–124, March 1957. (R. G. G., St. Thomas' Hospital, London, S. E. 1, England)

To investigate the features of Paget's disease associated with activity and its local spread, the authors recalled for examination 20 patients known to have the disease for whom roentgenograms taken two years earlier were available. It is pointed out that local osteoporosis is the essential and earliest radiological feature of this condition. Eight of the 20 patients showed radiological deterioration within the two-year interval. In each of these cases there was local osteoporosis at the site of the progressive changes, namely osteoporosis circumscripta in 3 cases, demarcation zone pathological fracture in 2 cases, incomplete fractures in 2 cases, and pathological fracture in porotic bone in 1 case.

These features did not occur in any of the "quiescent" cases and the authors believe that these changes are closely related to activity of the disease, supporting the contention that bone destruction is the essential, earliest and most active phase of Paget's disease.

Ten roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Hyperostosis Corticalis Generalisata. F. S. P. van Buchem and H. N. Hadders. Schweiz. med. Wchnschr. **87:** 231–236, March 9, 1957. (In German) (F. S. P. van B., Medizinische Universitätsklinik, Groningen, Germany)

The authors present a case of hyperostosis in a 30-year-old man, in addition to the 2 cases in siblings which they reported in 1955 (Acta radiol. **44:** 109, 1955. Abst. in Radiology **66:** 914, 1956). The patient was symptom-free and all clinical and laboratory findings were within normal limits except for a slightly elevated alkaline phosphatase.

Roentgenograms showed thickening and sclerosis in the skull, marked sclerosis and thickening in the mandible, sclerosis of the spinous processes of the vertebral column, sclerosis close to the acetabula, sclerosis of the ribs and clavicles, and thickening of the diaphyses of the long bones, as well as of the metacarpals and metatarsals and in portions of the phalanges.

In 1 of the 2 previously reported cases, in a 52-year-old female, autopsy was done and the complete skeleton was examined. The greatest changes appeared to be in the skull, with a markedly thickened base and vault, and in the mandible. The weight of the skull was 2,357 grams; of the mandible alone 265 grams. The optic foramina were narrow. The apophyseal joints of the spine showed synostosis. Some of the costovertebral joints were fused. The cortex of the diaphyses of the long bones revealed sclerosis, but the spongiosa appeared normal. The epiphyses were likewise normal.

Microscopic examination of the skeleton showed increased bony substance on the outside of normal corticalis. The new bone was entirely normal, structurally and chemically.

In addition to the bone changes, the autopsy showed a very small hypophysis. The parathyroids could not be found. The cause of death was apparently bronchopneumonia and not related to the bone findings.

The authors consider the differential diagnosis at some length. Among the conditions discussed in this connection are congenital diffuse osteosclerosis or Albers-Schönberg disease, which involves the epiphyses and metaphyses of the long bones but shows little involvement of the skull; myelosclerosis; hyperostosis generalisata with pachyderma (Uehlinger) in which joint involvement and marked skin changes are usually present; osteopathia hyperostotica multiplex infantilis (Engelmann's disease). This last condition shows symmetrical osteosclerosis of the diaphyses of the long bones and phalanges of the hands and feet, but skull changes are less marked.

The authors feel that the findings in their cases do not coincide completely with the findings in any of the diseases mentioned, but that they are similar to Camurati-Engelmann's disease.

Six roentgenograms; 1 photomicrograph; 4 photographs; 1 table. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Tuberculous Osteitis Pubis. Ellis Barnett. Brit. J. Radiol. **30:** 125–128, March 1957. (Hammersmith Hospital, London, W. 12, England)

The author presents 2 cases of tuberculous osteitis pubis, of particular interest because each patient had a cold abscess in the region of the space of Retzius. In 1 patient the changes in the pubis and the cold abscess were found during the course of intravenous pyelography carried out during the investigation of hypertension. The second patient was seen with a swelling in the left adductor region one year after a roentgenogram of the pelvis had shown irregularity of the symphysis pubis.

In the advanced stage, tuberculosis of the symphysis pubis may be suggested radiologically when irregular bone destruction, localized calcified debris, and cold abscesses are obvious, but in the earlier stages roentgen differentiation from mild osteomyelitis is not possible. However, the conditions can often be differentiated clinically. Tuberculous osteitis pubis often runs a painless course, the patient seeking medical advice only when a cold abscess or sinuses develop; or the condition may be discovered as an incidental finding on a radiograph of the pelvis. Other cases are characterized by pain in the pubic region or groin, perhaps extending down the anterior or medial aspect of one or both thighs, but the pain is never severe. Osteomyelitis, on the other hand, can be an extremely painful, disabling condition, well recognized as a complication of retropubic prostatectomy; seen less commonly following trauma or pelvic sepsis.

In 1 of the author's 2 cases a bladder calculus was suspected because of the opacity of the cold abscess in the space of Retzius; in the second instance the presence of other cold abscesses contributed to a correct diagnosis. The value of the lateral film of the pelvis to differentiate these two conditions is noted.

Four roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Fibrous Metaphyseal Defect of Bone. Crawford J. Campbell and James Harkess. Surg., Gynec. & Obst. **104:** 329–336, March 1957. (Albany Medical College, Albany, N. Y.)

The authors have studied 26 patients with localized benign fibrous lesions of the metaphyses of long bones. They pay particular attention to aspects peculiar to this condition, such as the simultaneous occurrence of multiple lesions, the association with osteochondroses, and the course. The series consisted of 20 males and 6 females between the ages of four and twenty-one years. In 19 patients the defect was in the distal femoral metaphysis (usually the posteromedial portion). Other sites were the proximal tibia in 5 patients, the distal tibia in 4, and the proximal humerus in 1.

Roentgenologically, the lesion appears as an oval or elongated area of radiolucency located eccentrically in the metaphysis of a rapidly growing long bone. The border is of scalloped contour and usually is slightly sclerotic. The defect may lie entirely within the cancellous bone of the metaphysis, partially in the cortex, or occasionally it may be situated in the outer margin of the cortex under the periosteum.

Multiple lesions were present in 8 of the 26 patients in this series. Also, 8 patients had one or more lesions in close proximity to an osteochondritis.

Curettage was done in 2 instances, following the healing of pathological fractures. Biopsy excision was performed on 2 lesions. Many regressed spontaneously within one to three years after their recognition.

The authors feel that the appearance of multiple foci, as well as concurrent osteochondritic lesions, suggests a common systemic etiology.

Thirty-four roentgenograms; 4 photomicrographs.

JOHN A. WARDEN, M.D.
University of Pennsylvania

Psoriasis and Arthritis. A Study of the Radiographic Appearances. V. Wright. Brit. J. Radiol. **30:** 113–119, March 1957. (The General Infirmary, Leeds, England)

The author analyzed the radiographic appearances of the hands, feet, sacroiliac and other involved joints in 39 patients with psoriasis and arthritis. Six with degenerative arthritis and 1 with gout showed radiographic changes typical of these conditions.

The radiographic changes in the 32 patients with psoriasis and erosive arthritis did not in general permit differentiation from rheumatoid arthritis, though they were usually less severe. The degree of soft-tissue swelling about a joint without damage of the underlying bone was often striking. Less commonly, however, a grossly destructive, deforming arthritis was seen.

The earliest changes were marginal erosions at the edge of the articular surfaces, but these were by no means pathognomonic of the syndrome. They occurred most frequently in the distal interphalangeal joints. Both in these joints and other phalangeal joints the base of the phalanx was sometimes expanded, giving the appearance of an inverted golf tee.

Not only the distal interphalangeal joints but the tips of the terminal phalanges were sometimes eroded, resulting in a shortened, pointed bone which appeared to have been whittled down. This advanced picture was not seen in a group of unselected patients with rheumatoid arthritis. The involvement of the terminal phalanges and the distal interphalangeal joints was sometimes related topographically to involvement of the nails.

There was a relatively high incidence of clinical ankylosing spondylitis among the patients with psoriasis and erosive arthritis and an even higher incidence of involvement of the sacroiliac joints as seen radiographically.

Fifteen roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Urticaria Pigmentosa, with Bone Lesions (Systemic Mast Cell Disease). F. R. MacDonald and Carleton B. Peirce. J. Canad. A. Radiologists **8:** 15–18, March 1957. (C. B. P., 687 Pine Ave., Montreal W. 2, Canada)

The authors report a case of urticaria pigmentosa with skeletal changes. These are described as "a peculiar demineralization of the bones of the ribs with coarsened trabeculation." Similar changes were found in the vertebral bodies, and demineralization was also observed in the pelvis and the inner table of the skull.

Four other cases have been reported in the literature in which skeletal changes described as "multicystic" or "cystic" osteoporosis were noted (see, for example,

Schorr, Sagher, and Liban: Acta radiol. **46**: 575, 1956. Abst. in Radiology **69**: 304, 1957). Those cases in which biopsy or autopsy specimens were available showed accumulations of tissue mast cells in the bone marrow.

Radiological differential diagnosis must consider the bone changes in comparison with early multiple myeloma. While the coarsened osteosclerotic appearance of the increased trabeculation may resemble osteitis fibrosa deformans, the authors feel that Paget's disease can be distinguished by the fibrillar or lamellated proliferation of bone, which is not observed in mast cell involvement.

Five roentgenograms. ALVIN S. SEGEL, M.D.
Cleveland City Hospital

Roentgen Studies of the Ruptured Lumbar Intervertebral Disk and Its Consequences. H. H. Weber. Radiol. clin. (supp.) **26**: 1–72, 1957. (In German) (Röntgeninstitut des Lindenhofspitals, Bern, Switzerland)

The author's conclusions concerning rupture of the intervertebral disk are based on 54 proved cases. Discography and myelography with a water-soluble, rapidly resorbing contrast material, supplementing the routine roentgen examination of the lumbosacral spine, are indispensable.

Spontaneous fissures in the nucleus and annulus begin even in early childhood, with involution of the blood supply to the intervertebral disk. The author regards this process as the essential endogenous cause for the later mechanical disturbances in the involved vertebral segment.

Attention is directed to the value of the roentgen demonstration of dorsal displacement of one vertebral body upon another. Even the slightest displacement is of importance as indicating a posterior rupture in the disk. The sign is early and irreversible. It was present in 96 per cent of the author's material. In three-quarters of the cases the herniation was directly under the dorsally dislocated vertebral body, and in one-fourth above. This sign may be absent in the "concealed ruptured disk or intermittent herniation" of American writers. The dislocation remains after operative removal of the prolapsed disk and leads to mechanical disturbances in the apophyseal joints, with secondary arthrosis.

Diminution of the intervertebral disk should not be underestimated as a sign of ruptured disk. Comparison of the height of the disk when the patient is lying down and upright is of value as an early sign of ruptured disk and herniation. When the patient is upright, muscle pressure causes an orthodynamic narrowing of the "decompensated" disk. However, the marked narrowing found in the old degenerated disk is constant, regardless of the position of the patient.

Clinically, the mechanical effects of disk herniation upon nerve roots are the cause of sciatica, and the arthrosis resulting from subluxation of the apophyseal joints may be considered a cause of lumbago.

Seventy-three figures; 3 tables.
CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Deviation of the Spinous Processes. Karel Lewit. Brit. J. Radiol. **30**: 162–164, March 1957. (Charles University, Prague, Czechoslovakia)

The author has found deviation of the spinous processes in about 80 per cent of healthy young adults. These occur most frequently in the thoracic spine but are by no means uncommon in both the cervical and lumbar regions.

Rotation of the thoracic spine appears to be the most important cause of root compression in this area. While deviation of the spinous processes need not necessarily mean the rotation of the entire vertebra, owing to the distance of the spinous process from the body of the vertebra, it is an incomparably more sensitive sign of rotation than deviation of the pedicles. Moreover, since the spinous processes are the point of muscular insertion, if the plasticity of bone is taken into account, deviation of the spinous processes is necessarily a sign of asymmetrical muscular pull; in other words, it is a sign of altered dynamics, of disturbed function.

Clinical experience and x-ray findings showed that in 78 per cent of 198 cases the pain corresponded precisely to the level at which deviation of the spinous process occurred; this has been shown to be frequently a sign of rotation. The importance of a change in the axis of the spinous processes at a given level is stressed. Deviation of the spinous processes is proof of a strain at a certain level and of altered dynamics of the spine. It should therefore be considered a *locus minoris resistentiae* for a given segment.

Six roentgenograms. THEODORE E. KEATS, M.D.
University of Missouri

Radiologic Examination of the Essential Scolioses. Pierre Stagnara, Pierre Quéneau, and Jean Archimbaud. J. de radiol. et d'électrol. **38**: 149–157, March–April 1957. (In French) (P. S., Lyons, France)

In considering treatment for scoliosis, one should establish whether the patient has postural or true scoliosis, the latter presenting structural alteration of the spine. It is important to know the type of scoliosis and the age of its appearance and to examine the spine every six months to show progression of changes. Roentgenograms of the entire spine should be obtained in the erect and decubitus positions. An anteroposterior view of the fifth lumbar vertebra is necessary to show whether it is normal, and a roentgenogram of the hand as a record of the relative skeletal or bone age.

In postural scoliosis, the curve of the spine is less severe in the decubitus position. If structural changes are present they persist in the decubitus position to almost the same extent as noted in the upright views.

The angles of curvature are determined in relation to neutral vertebrae between curves or at the ends of the single curve. The progression of these angles helps to determine whether fusion is necessary and when it should be done.

Nineteen roentgenograms; 4 graphs.
CHARLES M. NICE, JR., M.D., Ph.D.
University of Minnesota

Aneurysmal Bone Cysts of Spine. John W. Beeler, Charles H. Helman, and John A. Campbell. J.A.M.A. **163**: 914–918, March 16, 1957. (J. W. B., 23 E. Ohio St., Indianapolis, Ind.)

Aneurysmal bone cyst was identified as a distinct clinical, roentgenological, and pathological entity in 1950 (Lichtenstein: Cancer **3**: 279, 1950. Abst. in Radiology **56**: 305, 1951). The lesion occurs chiefly in children, adolescents, and young adults. In the cases discussed by the authors, the presenting symptom was pain that gradually became worse over a period of three

to seven months. In 3 patients there was encroachment on the spinal cord with resultant paralysis of the lower extremities.

Aneurysmal bone cysts are composed of irregular blood-filled spaces, ranging in size from a few millimeters to many centimeters in diameter. These spaces communicate freely. The septa that separate them are composed of osteoid tissue spindle-shaped stromal cells, and multinucleated giant cells.

The roentgen findings are considered specific when an expanded cyst-like area can be seen, delineated by a fine, sharply defined rim of periosteal bone. In some cases the thin cortical shell about the periphery of the tumor may be absent. The lesion may involve any part of the vertebra, but seldom if ever involves more than two adjacent segments of the spine.

The etiology of aneurysmal bone cyst is not known. All of the seven patients discussed received irradiation therapy. All the cysts regressed, but the rate of regression varied. Five patients recovered completely, and 2 showed considerable improvement.

Eight roentgenograms. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Giant-Cell Tumor of Bone Involving the Fifth Lumbar Vertebra. William G. Richards, Frank C. Coleman, and Noble W. Irving. J.A.M.A. **163:** 731–733, March 2, 1957. (F. C. C., Mercy Hospital, Fourth and Ascension St., Des Moines 14, Iowa)

Giant-cell tumor of bone is now recognized as being only one of a group of bone lesions that contain giant cells. In this group the lesion most likely to be confused with a giant-cell tumor is the aneurysmal bone cyst. The differentiation is important, since the tumors may recur after curettage while recurrence of an aneurysmal bone cyst is rare. Giant-cell tumors may show sarcomatous change in a significant number of cases while malignant change in an aneurysmal bone cyst is unusual.

The authors report a giant-cell tumor in the fifth lumbar vertebra of a twenty-three-year-old woman who first began having low-back pain in March 1952. Roentgenograms made in November 1952 showed a destructive process involving the fifth lumbar body, lamina, and transverse process on the right side. There was no bone production, but a soft-tissue mass could be seen overlying the area of bone destruction. The major portion of the lesion was removed by surgical exploration and the microscopic diagnosis was giant-cell tumor, Grade I to II. The surgeon felt that the tumor had not been completely removed and, for that reason, three courses of postoperative irradiation were given, between December 1952 and July 1954. Examination in September 1955 showed the patient to be in good general condition, and it was felt by the examiner that healing had progressed satisfactorily.

Two roentgenograms; 1 photomicrograph.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Hypertrophic Osteosclerosis (Bony Spur) of the Lumbar Spine Producing the Syndrome of Protruded Intervertebral Disc with Sciatic Pain. Max T. Schnitker and Francis C. Curtzwiler. J. Neurosurg. **14:** 121–128, March 1957. (St. Vincent's Hospital, Toledo, Ohio)

The authors have analyzed a series of 154 patients on whom laminotomy was performed for the lumbar disk syndrome and found that 9 of this group (5.8 per cent) had localized hypertrophic osteosclerosis (bony spur), without evidence of disk injury. Eight of the 9 patients were females, whereas in a large series of protruded lumbar disks, males predominated in a ratio of 2 to 1. In 7 of the 9 cases a fall on the buttock was thought to be a common precipitating factor. Pain in the back and leg was of immediate onset following the injury in all 9 cases but it was not as severe and dramatic as in some cases of true disk herniation.

Physical findings were typical of disk protrusion, with segmental motor, sensory, and reflex changes, with three notable exceptions: (1) Normal lumbar lordosis was maintained in 6 of the 9 cases, while it is usually lost in lumbar disk herniation. (2) Acute flexion of the neck failed to produced pain in 5 patients, whereas this test is commonly positive with true disk protrusion. (3) There was no appreciable body list in any of this group of cases, such as is frequently seen with ruptured disks.

Obliquity of the facets at the suspected level was a constant roentgen finding. Also at the level of the deformity there was what the authors call a "bulbous facet," at the arthrodial joint on the involved side, of the anteroposterior type. With this deformity there may be an associated bony spur formation that projects into the vertebral canal, with compression of the nerve root. Myelography may fail to show any indentation of the caudal sac but, if the bony spur is large, it may cause a concave myelographic deformity that is longer and more smooth than that produced by the usual protruded disk (compression by the ligamentum flavum). It is also stated that this deformity, as shown in the myelogram, will tend to be at a level of the lateral portion of the laminal arch and interarticular isthmus rather than at the level of the intervertebral disk. Careful comparison of the myelogram with the routine anteroposterior view shows that the defect conforms precisely to the medial aspect of the "bulbous facet" that appears to protrude into the lumbar canal.

At operation the bony eburnation was found to arise from the medial margin of the facet or adjacent to the facet. Eight of the 9 cases showed the bony spur formation occurring at the L4-L5 level. In 2 of the cases the nerve root was found encased within a bony tunnel and was compressed by the exostosis. In 2 of the cases there was a hypertrophied ligamentum flavum, adding to the compression. No protruded or extruded or "hidden" disks were found in any of these 9 patients.

Six roentgenograms; 1 photograph.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

The Vacuum Phenomenon at the Anterior Borders of the Lumbar Vertebrae. K. Vollmar. Radiol. clin. **26:** 75–79, March 1957. (In German) (Strahleninstitut der Allg. Ortskrankenkasse, Machabäerstrasse 19–27, Cologne, West Germany)

What the author calls a "vacuum phenomenon" is a small fissure or tiny area of radiolucency at the upper or lower anterior angle of the lumbar vertebrae. The actual bony angles of the vertebral bodies are more or less deformed, prominent, and sclerotic. These associated bony changes are, in the main, due to the stress of wear and tear on the vertebrae, with secondary injury to the intervertebral disks in the anterior portion, with defects in the fibrous ring.

The author observed 3 such cases within a month

and believes that the phenomenon is not so rare as might be supposed, being easily overlooked or attributed to overlying intestinal gas. The films must be of optimal quality.

[The abstracter has noticed this phenomenon on several occasions, even before reading this article, and can confirm that it is not rare.—C.V.C.]

Three roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Pantopaque Intravasation (Embolization) During Myelography. Edwin M. Todd and W. James Gardner. J. Neurosurg. **14**: 230–234, March 1957. (Cleveland Clinic Foundation, Cleveland, Ohio)

The authors believe that intravasation of Pantopaque during myelography is more common than the paucity of reported cases would indicate. They describe a case in which the medium passed from the subarachnoid space into the anterior epidural venous plexus along the forwardly displaced spinal needle. Roentgenograms of the skull taken a day after myelography demonstrated numerous faint linear streakings suggesting that the material was in the veins rather than in the subarachnoid space. Continuous coughing may have effected rapid changes in intrathecal and venous pressures resulting in a cephalad surge of the medium along the network of venous plexuses, with ultimate ascension into the intracranial venous system. No intracranial symptoms were produced and, unfortunately, no subsequent roentgenograms of the skull were taken, so that this supposition remains unsubstantiated. Nor were the authors able to present roentgen confirmation of Pantopaque embolization in the lungs.

The epidural space is composed of a rich network of intercommunicating venous plexuses and it has been well established that the pressure within these veins is considerably less than that within the spinal fluid sac under normal circumstances. Several investigators have demonstrated the passage from the intrathecal space into the venous systems. They state that this experience may be attended by immediate symptoms, a delayed reaction, or no clinical evidence of abnormality. The potential for serious sequelae is not known, as recorded experience is hardly sufficient for significant conclusions. In all published cases, symptoms and clinical manifestations were transitory.

In those cases in which there is apparent discrepancy between the amount of medium injected and withdrawn, or when an irritative cough, mild distress in the chest, and an associated febrile reaction attend or follow myelography, especially in the presence of a bloody tap, intravasation is suggested as a reasonable explanation. A case report along with three reproductions showing intravasation of the Pantopaque into the venous system is included.

ARTHUR J. COOK, M.D.
Atlanta, Ga.

GYNECOLOGY AND OBSTETRICS

A Statistical Comparison of the Therapeutic Value of Carbon Dioxide Insufflation Versus Oil Salpingography. William C. Weir, David R. Weir, and Arthur S. Littell. Am. J. Obst. & Gynec. **73**: 412–417, February 1957. (Western Reserve University School of Medicine, Cleveland 6, Ohio)

The authors studied 100 selected infertile women with no apparent physical defects for evaluation and comparison of the therapeutic effects, if any, of carbon dioxide insufflation and salpingography in the presence of normal tubal patency.

The probabilities of conception occurring for the three periods of time, (*a*) pre-CO_2 insufflation, (*b*) post-insufflation presalpingogram, and (c) postsalpingogram were determined. In this group, most of whom had had previous insufflation, CO_2 insufflation had no demonstrable therapeutic effect. Iodochlorol or Lipiodol, the agents used for oil salpingography, were demonstrated to have apparent therapeutic value. The chances of conception by the fourth ovulation in the preinsufflation period and the postinsufflation presalpingogram period were approximately the same, 1 in 10, whereas in the postsalpingogram period they were 1 in 3.

In the study and treatment of infertility, CO_2 insufflation should be primarily a screening test, with oil salpingography for diagnosis in negative or doubtful cases. Oil salpingography should be used for therapy when all the data have been collected and its maximum therapeutic effect can be attained either alone or in conjunction with other treatment.

One figure; 3 tables.

ROBERT L. EGAN, M.D.
University of Texas, Houston

The Roentgen Demonstration of the Fetus in Utero by Means of Fetography. H. Kräubig. Fortschr. a. d. Geb. d. Röntgenstrahlen **86**: 351–356, March 1957. (In German) (Universitäts-Frauenklinik, Göttingen, Germany)

Malformations of the soft tissues of the fetus in the uterus can be demonstrated radiologically only by means of amniography or fetography. Amniography is the artificial opacification of the amniotic fluid, which indirectly permits visualization of the soft-tissue outline of the fetus. Fetography calls for intrauterine injection of a special iodine-containing substance which has a particular affinity for the vernix caseosa, thus forming a thin radiopaque covering of the entire skin of the fetus. An x-ray film of the abdomen will then show the skeleton and also the external outline of the soft tissues. Hydrops of the fetus can be plainly demonstrated.

Fetography represents a marked advance over amniography, being much less dangerous. Nevertheless, as there is always the danger of perforation of a large vessel, the indications are strictly limited. In the author's opinion, the procedure is indicated in acute hydramnios, because in this condition a puncture of the uterus is indicated in any case and fetography is only an additional procedure; in ordinary hydramnios, if cesarean section is contemplated; in cases with a history of several malformations; in diabetics if a cesarean section is planned; and particularly in erythroblastosis, to determine whether there is a hydrops of the fetus. The positive diagnosis of hydrops may save the mother a cesarean section.

The author's technic is as follows: A 1.5-mm. spinal-puncture needle is inserted below the umbilicus either on the right or left side (wherever the small fetal parts are), 15 to 20 c.c. of amniotic fluid is withdrawn, and a similar quantity of warm Immetal (dijoderuca acid-isobutylester) is injected. The patient is then rolled about repeatedly in order to distribute the injected material properly, and films are taken six to seven hours later.

The films are quite striking. Fingers, toes, ears, and genital organs can usually be shown. Malformations or

hydrops is well recognized. In the author's series no harmful effect occurred to mother or child.

Four cases are described in which the fetography was the deciding factor as to whether or not a cesarean section should be done.

Seven roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

THE GENITOURINARY SYSTEM

Effectiveness of Urologic Contrast Media. Comparison Between Diodone and Triiodyl (Sodium Acetriozoate). Erik Madsen. Acta radiol. **47:** 192–198, March 1957. (Municipal Hospital, Copenhagen, Denmark)

The results of an investigation carried out to assess the effectiveness of Diodone (molecular weight 477, 55 per cent iodine per molecule) and Triiodyl, the Danish equivalent of Urokon (molecular weight 579, 65.8 per cent iodine per molecule) as urographic contrast media are reported. The investigation took the form of comparative urographic studies combined with chemical estimation of the iodine contents in the urine.

For quite a long period, both Diodone and Triiodyl were used for urographic studies and patients with repeat investigations were given the two contrast media. It was observed that in most cases the urograms were better with Diodone than with Triiodyl, the excretion being more rapid, the filling of the calyces better, and the density of the shadows fully as good. As this result was in conflict with most other reports, an endeavor was made to supplement the urographic results by chemical estimations, which unequivocally supported the radiographic assessment as to the diagnostic value of the contrast media.

A total of 10 normal subjects were submitted to urography on two occasions, once with 20 ml. of Diodone 50 per cent and once with Triiodyl 50 per cent, at an interval of at least two days. During this investigation, a catheter was inserted into the bladder and urine collected at five-minute intervals for thirty minutes after the injection. The quantity and iodine concentration of each specimen were then determined by the addition of saturated bromine water to and titration with sodium thiosulphate.

Although the iodine content per molecule of Triiodyl is greater than that of Diodone, a possible explanation for the better filling of the calyces with Diodone is the difference in tubular excretion of the two media. As pointed out by Keates (Brit. J. Radiol. **27:** 236, 1954), the diuresis following the intravenous injection of contrast media is due to the osmotic effect of the high concentration they reach in the urine. The lower molecular weight of Diodone causes more molecules to pass out into the tubules, which makes the osmotic pressure greater and this in turn will act to increase the urinary output.

Triiodyl, however, has its range of indication when patients cannot be prepared in the usual way or when renal concentration is reduced. It has been observed, with the use of Triiodyl, that if the patients are allowed to drink water prior to the examination, the urine output is increased and the iodine excretion brought up to or above the level seen with Diodone.

Six diagrams.

RITA M. BRADY, M.D.
University of California, S. F.

A Comparative Evaluation of Intravenous Pyelographic Media. A. Waite Bohne and Dale R. Drew. Arch. Surg. **73:** 927–930, December 1956. (Henry Ford Hospital, Detroit, Mich.)

In an attempt to evaluate the efficacy of intravenous pyelographic media the authors made a blind comparative study of 800 cases. The media used were Urokon 50 per cent and 70 per cent, Miokon 50 per cent, Hypaque 50 per cent and Renografin 76 per cent. Each of the four media was given to 200 patients and the quality of the resulting pyelograms was reported, as well as the types and percentage of reactions. Each medium was administered intravenously after preliminary intradermal injection of 0.1 c.c. of a 1 : 15 dilution in those patients with an allergic history.

The results indicate that there was no significant difference in the quality in the four media. There were fewer reactions, all things considered, with Miokon, Hypaque, and Renografin than with Urokon 50 and 70 per cent.

Two charts; 1 table.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Pyelo-ureteral Roentgenkymography. Giovanni Juliani and Alessandro Gibba. Radiol. med., Milan **43:** 209–225, March 1957. (In Italian) (G. J., Istituto di Radiologia dell'Università di Torino, Turin, Italy)

Ureteral roentgenkymography is preferably performed after retrograde instillation of contrast medium, because of the better opacification [those interested in technical details are referred to the original article]. Under physiologic conditions, the ureteral wave progresses distally, but antiperistalsis is not uncommon and explains how an intramural calculus can return to the kidney pelvis. The average speed of the peristaltic wave varies between 2 and 6 cm./sec., seldom less (hypokinetic), exceptionally more (hyperkinetic); akinesia is definitely pathological and indicates serious damage. The renal excretory rate determines the frequency of the contractile waves, usually three or four per minute, but retrograde instillation often causes overdistention, and sometimes nine or even more waves per minute have been seen (intravenous urokymography seems more physiological at first glance, but ureteral compression and other maneuvers required for good visualization are even more disturbing than gentle retrograde pyelography). Marked overdistention of the kidney pelvis may halt peristalsis altogether (akinetic effect). The shape and the amplitude of the ureteral waves, as seen on the kymogram, are perhaps the most important elements. The authors state that in two otherwise similar cases of obstructive hydronephrosis, preoperative urokymography enabled them to predict with accuracy whether functional rehabilitation would or could not occur after removal of the intramural calculus.

Nine illustrative case reports are included.

Twenty-nine roentgenograms; 3 drawings.

E. R. N. GRIGG, M.D.
Cook County Hospital

Bilateral Wilms' Tumour. P. P. Rickham. Brit. J. Surg. **44:** 492–495, March 1957. (Liverpool, England)

Two cases of bilateral Wilms' tumor are reported. One was untreated; the tumors grew rapidly, and death occurred ten weeks after examination.

The second infant, with a one week history of vomiting and abdominal distention, was shown by intrave-

nous pyelography to have bilateral renal tumors. At surgery, the entire left kidney was found involved and was removed. About three-fifths of the right kidney contained gross tumor and was removed, along with the para-aortic nodes and the perirenal fat. Postoperative irradiation was given to the whole abdomen through parallel opposing fields (250 kv., h.v.l. 1.5 mm. copper, 1,700 r to each field in thirty-one days). The tumor dose was 2,800 r, but the remains of the right kidney were shielded after a dose of 2,000 r had been given to that region. The blood urea nitrogen remained elevated for six months after operation. Urea clearance fourteen months after operation was normal. Intravenous pyelograms showed great hypertrophy of the remaining part of the kidney. The patient was alive without evidence of disease eighteen months after operation.

Only one other long-term survival of a patient with bilateral Wilms' tumor has been reported. This was also treated by operation plus radiotherapy (see Gross: The Surgery of Infancy and Childhood. Philadelphia, W. B. Saunders Co., 1953).

Seven photographs.

CAPT. GARTH R. DREWRY
MacDill AFB, Fla.

THE ADRENALS

Preoperative Differentiation Between Hyperplasia and Tumor in Cushing's Syndrome. Frank Hinman, Jr., Howard L. Steinbach, and Peter H. Forsham. J. Urol. **77**: 329–338, March 1957. (384 Post St., San Francisco 8, Calif.)

Cushing's syndrome may be caused by bilateral hyperplasia of the adrenals, or by an adenoma or carcinoma, practically always unilateral. Obviously the surgeon needs to know beforehand whether one or both sides must be explored.

Basal levels of 17-hydroxycorticoids are moderately elevated in hyperplasia; slightly elevated and changing in adenoma; considerably elevated and fixed in carcinoma. The stimulation test with ACTH produces characteristic changes in the levels of the 17-hydroxycorticoids as follows: normal adrenals respond with three to five times the basal level, less than 50 mg./day; hyperplasia also three to five times basal level, totaling more than 50 mg./day; adenoma gives a five to seven times response; carcinoma shows no rise. The levels of the 17-ketosteroids were also studied but proved to be less reliable, as did the suppression test using fluorocortisone.

Plain films are rarely diagnostic in adrenal disorders. Excretory urograms are only occasionally helpful, in ruling out confusing renal masses, and retrograde pyelograms have been found of no value. Presacral air injection followed by tomography is highly accurate, having afforded a correct diagnosis in 18 out of 20 cases studied. The best evidence was the presence of a mass on one side and contralateral atrophy.

Eight roentgenograms; 1 chart; 6 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

MISCELLANEOUS

Radiographic Findings in Certain Diseases Peculiar to a Subtropical Climate. Gerard Raap. South. M. J. **50**: 189–194, February 1957. (908 Huntington Bldg., Miami, Fla.)

The author reviews a few uncommon diseases which may occasionally be encountered in the South, either as importations or as examples of indigenous disease. These include malaria, ainhum, leprosy, amebiasis, echinococcus cyst, mango bezoar, ascariasis, screw-worm infestation, and schistosomiasis.

RADIOTHERAPY

Planned Combination of Surgery and Radiation in Treatment of Advanced Primary Head and Neck Cancers. William S. MacComb and Gilbert H. Fletcher. Am. J. Roentgenol. **77**: 397–414, March 1957. (University of Texas, M. D. Anderson Hospital and Tumor Institute, Houston, Texas)

This is a relatively brief outline of a method of treating cancers of the head and neck, with illustrative cases.

Cancers of the *paranasal sinuses* are first treated surgically, with removal of as much neoplastic tissue as possible. In the presence of involvement of the floor of the orbit or the ethmoids, the oribit should be exenterated. The type of postoperative irradiation depends upon the histology of the tumor, its site of origin, and extent. If the residual disease can be localized to one area, intracavity irradiation by radium or cobalt 60 is used, the dose being 7,000 to 8,000 r in seven to ten days. Less well confined disease is treated by external roentgen therapy with a dose of 7,000 r in six weeks, delivered with 250 kv, or 6,000 r in four weeks with cobalt 60. The tolerance to radiation is better in postoperative cases than in nonoperated cases.

Lesions of the *oral cavity* are treated by either surgery or by irradiation. Surgery is usually radical, but the prognosis is good if the disease is not too extensive. The cosmetic results, however, are poor, and recurrences are frequent because of the large volume of tissue involved and abundant paths of metastasis. Radiation therapy is best given by a combination of radium and x-rays, with a dose of 3,000 to 4,000 gamma roentgens followed by 3,000 to 4,000 r delivered by x-rays through two opposing fields over a period of four weeks. This brings the total tumor dose to 7,000 r delivered in about five weeks. Cobalt-60 teletherapy and 22-MEV betatron irradiation are now being used, and appear more effective than conventional x-ray therapy. Radical neck dissections are performed for lymph node involvement.

Results in *extrinsic laryngeal lesions* have been unsatisfactory. Panlaryngectomy is performed, with neck dissection if the lymph nodes are positive. External irradiation is then given to the entire neck area. This may be supplemented by radium implantation. In tumors involving cartilage, membranous areas, and poorly vascularized areas, such as the pre-epiglottic fossa, irradiation has often proved unsuccessful because, even if the cancer is eliminated, intractable pain may occur as a result of subsequent necrosis and infection. The x-ray dosage is 6,000 to 7,000 r, delivered in seven to eight weeks. The dosage of radium is 3,000 to 4,000 gamma roentgens. Tolerance of 250-kv x-rays is poor if the area is large. Tolerance for cobalt-60 and betatron therapy is better.

For *parotid-gland tumors*, surgery is the procedure of choice. It may not be possible, however, to remove completely large tumors with extension into the base of the skull. In these, surgery may be followed by tangential therapy, with a wedge filter. Interstitial implants should be reserved for tumors localized to the lower pole of the parotid.

The effectiveness of the treatment of head and neck lesions depends on careful planning, judicious use of surgery, and thoughtful radiotherapy. It would appear that supervoltage therapy affords better results than conventional irradiation.

Eleven roentgenograms; 10 photographs; 13 diagrams; 1 table.

PAUL MASSIK, M.D.
Quincy, Mass.

Cancer of the Tongue: A Study Based on 653 Patients. Stanford Cade and E. Stanley Lee. Brit. J. Surg. **44:** 433–446, March 1957. (Westminster Hospital, London, England)

All but 8 of the 653 cases of cancer of the tongue seen by the authors and their colleagues from 1925 to 1955 were squamous carcinoma. The sex ratio in recent years is 2 males to 1 female, compared with 10 to 1 in 1925–29, the decreased incidence in men being correlated with decreases in oral sepsis and positive Wassermann reactions.

Radium implantation is the main method of treatment in lesions of the anterior two-thirds of the tongue, for a dose of 7,000 to 8,000 r in seven days. Teletherapy by radium, cobalt, or 2-million-volt x-rays is used for lesions inaccessible to accurate implantation (including base of tongue), very large lesions, and lesions where slow treatment is an advantage (large ulcerated lesions, lesions involving bone, and lesions with much sepsis and edema). Palliative excision or coagulation by diathermy is useful in lesions beyond the range of excisional surgery and in cases not responding fully to radiation. Radical surgery, with hemimandibulectomy and block dissection of the neck, is used in a small group of cases, especially those resistant to radiation and those invading the undersurface of the tongue and the gingival mucosa.

Radical neck dissection was done in 117 of the 653 cases. Criteria for neck dissection are: (1) control of the primary lesion; (2) operable nodes, not very large or fixed to the carotid sheath or accompanied by extensive skin infiltration; (3) palpable nodes. In only 3 cases was prophylactic neck dissection done. External radiation is advised after block dissection when histologically positive nodes are found. Inoperable cervical nodes are treated with extensive single-plane radium implants to a dose of 6,000 r in seven days, or with external radiation.

The five-year survival rate for cases treated up to the end of 1950 was 27 per cent of 461 determinate cases (24 per cent of 518 total cases). The five-year survival for lesions less than 2 cm. in diameter and confined to the tongue was 60 per cent; for primary lesions not confined to the tongue, 16 per cent; for cases with no nodes when first seen, 51 per cent; with nodes present when first seen 14 per cent; for lesions confined to the anterior two-thirds 35 per cent; for those involving the posterior third 11 per cent. Although histologically less differentiated tumors tended to be more malignant, faster growing, and more radiosensitive, the differences were not constant enough to form a basis for treatment or prognosis.

Of the 124 five-year survivors, 18 per cent later died of their disease. The palliative value of a radium implant is emphasized, since 95 per cent of the small lesions and 64 per cent of all the lesions thus treated were satisfactorily healed for "at least a year or so."

Ten roentgenograms; 19 photographs, including 3 in color; 6 drawings and charts; 15 tables.

Capt. GARTH R. DREWRY
MacDill AFB, Fla.

Mixed Tumor of the Submaxillary Gland, Treated by Surgery and Radiation, Followed Eighteen Years Later by Carcinoma of the Thyroid. Herman Charache. J. Pediat. **49:** 733–737, December 1956. (75 Prospect Park Southwest, Brooklyn 15, N. Y.)

The case reported here is the only one on record of a mixed tumor of the submaxillary gland in childhood treated by excision and postoperative radiotherapy, with carcinoma of the thyroid developing eighteen years later.

The patient first noticed a lump in the right submaxillary region at the age of twelve, but no medical advice was sought for two years. In 1932, when she was fourteen, the tumor was excised and she was referred for roentgen therapy; 860 r was given in one series and 215 r in another. In 1937, a tumor the size of a walnut was discovered at the site of the former operation; this was excised and two radon tubes of 25 mc. in a rubber jacket were placed in the tumor bed for a total of 1,800 mc. hours. The patient was seen again in 1947, at the age of twenty-nine. Multiple, discrete nodules had developed in the right submaxillary region and along the anterior cervical chain. A radical neck dissection was carried out; the pathologic report was "mixed tumor of salivary gland origin." In 1950, at the age of thirty-two, the patient was admitted to the hospital with an "adenoma of the right side of the thyroid." On thyroidectomy, this proved to be a papillary carcinoma. Postoperative radiotherapy was given and also radioiodine. The patient was last seen in 1956, at the age of thirty-eight. The neck was free from any recurrence or metastasis. During the twenty-four years this patient has been under observation, numerous roentgenograms of the skeleton have been taken; all have been negative for disease.

The author believes the cause-and-effect relationship of radiotherapy as a carcinogenic factor in thyroid carcinoma in children must be kept in abeyance until more clinical evidence is available. In the meantime one should hesitate to recommend radiotherapy for children in nonmalignant conditions of the head, neck, and chest as long as there are other modalities available.

Four photomicrographs.

Radiotherapeutic Experiences with Inoperable Lung Carcinoma. Lewis L. Haas, Roger A. Harvey, and Charles F. Melchor. Cancer **10:** 280–297, March-April 1957. (R. A. H., Department of Radiology, University of Illinois College of Medicine, Chicago 12, Ill.)

The authors discuss their experiences with radiotherapy in 190 cases of inoperable lung cancer seen at the University of Illinois College of Medicine; 47 patients (25 per cent) were treated by the 23-MEV betatron and 143 (75 per cent) by conventional x-rays. The authors do not intend to irradiate patients with operable tumor, at least not until a reliable standard technic has been found that may yield results compa-

rable with those obtained with surgery. They do not irradiate as a prophylactic measure patients who have had complete surgical removal of the tumor. They do give irradiation to patients who have been operated on if they have inoperable residual tumor or a recurrence. The great majority of patients with inoperable lung cancer, even if it is in a very advanced stage, are treated by irradiation. Age is not a contraindication but irradiation may be inadvisable in a patient in a very poor and long-standing cachectic condition. Cavitation in the tumor and pleural involvement are unfavorable prognostic signs, but they are not in themselves an absolute contraindication to radiotherapy.

The cases are divided for practical expediency into five groups, on the basis of their response to radiotherapy:

1. *Apical lung tumors* (18 cases): Although this type of lung carcinoma is regarded universally as the worst and most resistant, in the authors' experience this group yielded the best radiation results. Of 8 patients treated by conventional roentgen therapy, 1 is alive for eleven years. Of 10 patients treated by the betatron, 2 were alive and well for fifteen and thirty-one months respectively after irradiation, without evidence of tumor. The patients who died after conventional roentgen therapy survived up to nine months, an average of six months; those who died after betatron therapy, up to four years, an average of 19.6 months.

2. *Small or clinically undetectable primary bronchial lesions, with a dominating large secondary tumor mass in the upper mediastinum* (4 cases): All 4 patients in this group were treated with the betatron; in each instance the mediastinal and pulmonary lesions disappeared and the clinical symptoms, including superior vena cava syndrome, regressed. Two of the patients died of generalized metastases, one of intercurrent disease without evidence of tumor after ten months, and one of perforated trachea, also without tumor, after sixteen months of useful life.

3. *Central-bronchial occluding tumors with massive pulmonary atelectasis* (11 cases): In patients in this group, the occlusion usually occurs in advanced stages when the vascular and lymphatic pathways are already invaded. Yet a rapid resolution of the occluding bronchus takes place frequently, with concurrent re-aeration of the atelectatic lung field. Eight patients were irradiated with conventional roentgen rays and 3 with the betatron. Two of the 11 survived for more than three years and 1 for more than two years; 1 betatron-treated patient is alive for more than thirteen months without evidence of tumor.

4. *Lung tumors with unresectable regional extensions that are either peripheral or central mediastinal* (36 cases): This group represents a slightly less advanced stage than Group 5. Of 10 patients treated with the betatron, 2 were alive without tumor evidence for more than fourteen and fifteen months. Of 26 treated with conventional roentgen rays, 3 lived for more than twelve months. The majority died of metastatic disease within ten months.

5. *Very advanced, hopeless cases that are too extensive for radical irradiation, multicentric, invading the lumina of blood vessels or several regional lymph nodes or adjacent vital organs, or metastasizing to the contralateral lung or to extrathoracic organs* (121 cases): It is unfortunate that the majority of patients were received in this hopeless stage. Either the lesion was too widespread for radical irradiation or metastatic spread was certain. Twenty patients were treated with the betatron and 101 with conventional x-rays. Only 3 patients lived for more than twelve months. Palliation was, in general, of shorter duration and less marked than in the other groups. The authors believe, however, that it is impossible to praise highly enough the temporary relief and shortening of the terminal suffering afforded by the radiation.

Of 47 betatron-treated patients, 10 (21.4 per cent) lived for more than twelve months; 5 were alive without evidence of tumor at the time of writing. Of 143 patients treated by conventional roentgen rays, 6 (4.2 per cent) were alive more than twelve months; 10 (7.0 per cent) lived for more than twelve months. Appreciable clinical palliation of varying duration was achieved in 41 (87 per cent) of the betatron-treated patients; radiological regression in 31 (65 per cent). Of the roentgen-ray treated patients clinical palliation was seen in 57 (40 per cent); radiological regression in 41 (29 per cent).

Results were much better in all groups after high-voltage radiation than after conventional roentgen therapy. While the biological effects of the two types are not different, the high-energy radiation may deliver a higher tumor dose more easily, with more homogeneous distribution in the tumor. Another point favoring high-energy radiation is that the treatment was planned and carried out in the experimental stage of the betatron, with great care, by experienced physicians, while the conventional roentgen therapy was given in the daily mass program, with varying technics, by several physicians, most of whom were less experienced residents. The authors' impression is that high-voltage therapy does have definite advantages in the treatment of lung cancer, but that conventional roentgen rays will accomplish good results if the same care is exerted in the treatments.

Twenty-five roentgenograms; 1 photograph; 2 photomicrographs; 6 graphs; 8 tables.

The Status of Radiotherapy in the Treatment of Mammary Carcinoma. Robert McWhirter. Strahlentherapie **102**: 456–465, March 1957. (In German) (Department of Radiotherapy, The Royal Infirmary, Edinburgh, Scotland)

The value of radiotherapy of breast cancer is still being disputed, mainly due to inadequacy of treatment methods. The value of surgery is likewise not clarified because radical mastectomy cases only are considered by the surgeons, while inoperable cases are disregarded. If the latter were included in surgical statistics, the actual survival rate would be much lower than is apparent from available reports. In addition, indications for radical mastectomy vary from clinic to clinic.

At the Royal Infirmary (Edinburgh), 2,507 cases were seen from 1941 to 1949, which means approximately 260 new cases per year. The operability rate of this group was 58 per cent. The results of surgery have been disappointing, because there was marked decrease of the survival rate as soon as axillary nodes were affected. This poor result has been explained in recent years by the observation that when axillary nodes are involved simultaneous spread to supraclavicular and intrathoracic nodes occurs in 60 per cent of the cases. Therefore, a so-called super-radical mastectomy has been introduced by some surgeons. Survival rates of the new method have not been made available as yet.

In Edinburgh it was decided to treat affected axillary

as well as supraclavicular and intrathoracic nodes with roentgen rays rather than with extended surgery. The total dose for each of the three groups was 3,750 r, administered within a period of three weeks. Metastatic nodes reponded well to radiation, being much less radioresistant than the primary breast tumor. Therefore, only a simple mastectomy was performed in most cases, and radiation therapy was started on the tenth postoperative day. Edema of the arm developed only very rarely with this method.

Radical mastectomy was done only (1) in the very obese, (2) in peripheral vascular disease, and (3) in the presence of connecting cords between the breast tumor and the involved axillary nodes.

With this treatment plan the following observations have been made: (1) In the early stage, the results are the same with (*a*) radical mastectomy and (*b*) simple mastectomy plus roentgen therapy. (2) When supraclavicular or intrathoracic nodes are involved, radical mastectomy is ineffective and simple mastectomy combined with radiotherapy is superior. (3) When axillary nodes are involved, but not the supraclavicular or intrathoracic nodes, opinions are still divided as to the relative value of the two methods of therapy. (4) When tumors are located in the medial segments of the breast, the intrathoracic nodes are affected in a high percentage of cases. Therefore, the results with radical mastectomy remain poor, and better results have been achieved with irradiation in this group. This observation suggests also superiority of roentgen therapy of the axillary nodes, which, from a technical standpoint, can be reached more easily than other nodes. (5) In the inoperable group radiotherapy has succeeded to some extent. At times, response of axillary nodes has been so satisfactory in this group that simple mastectomy could be performed afterward.

Most of the cases showing five-year survivals have been treated with simple mastectomy plus roentgen therapy. This latter method is really more radical than radical mastectomy because twice as many cases can be considered for this treatment. Combined therapy, however, is not considered the final solution of the therapeutic problems, and the author is now in the process of investigating supervoltage therapy.

Ten tables.

ERNEST KRAFT, M.D.
Northport, N. Y.

Cancer of the Breast, 1,661 Patients. II. Considerations in the Failure to Cure After Radical Mastectomy. Robert C. Hickey. Am. J. Roentgenol. **77:** 421–430, March 1957. (College of Medicine, State University of Iowa, Iowa City, Iowa)

From 1926 to 1949, 1,661 patients with cancer of the breast were seen at the State University of Iowa Hospitals. The five-year survival rate for this series was 36.8 per cent. For 913 cases treated by radical mastectomy, it was 46.8 per cent.

There are a number of factors concerned in survival and failure. These the author considers individually. The most important factor is the stage of the disease, early cases having a better prognosis and late cases having a poor survival rate. Discovery of the cancer is generally made by the patient and it is she who must initiate the train of events leading to treatment. In this series there was a median delay of seven months between the appearance of symptoms and treatment. Physical signs are a reflection of the stage of advancement of the lesion. The following signs are indicative of far advanced disease and indicate a poor prognosis: large open ulcers, satellite skin nodules, fixation to the chest wall, inflammatory carcinomas, edema of the arm and of the breast. Age and the menopausal status had no influence on survival. Males generally did less well than females. Patients with concomitant diseases did poorly. Radiation therapy failed to protect against recurrences. Recurrences were high if the axillary lymph nodes were involved.

It is difficult to prognosticate in any case because of the number of variables, which include rate and route of dissemination, biological activity of the cancer, and resistance of the host. The lymphatic drainage varies with the primary site, but the main drainage area is the axillary lymph node system.

Classical radical mastectomy is a proved surgical procedure and the results in the area from which this report comes are reasonably predictable if all variables are considered. Margottini (Sixth International Cancer Congress, São Paulo, Brazil, 1954) claimed an improvement in results of 15 per cent with super-radical surgery, but the overall benefits of this procedure, as of supplemental irradiation, remain questionable. New technics, new drugs and new methods may be of benefit. Radiation therapy is helpful for palliation in inoperable cases.

Five graphs; 1 drawing; 5 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

The Preoperative Irradiation of Breast Cancer. Otto Bismarck. Strahlentherapie **102:** 466–467, March 1957. (In German) (Strahlenabteilung des Stadtkrankenhauses-Poliklinik Süd, Halle a. S., East Germany)

Preoperative irradiation of breast carcinoma is used with ever-increasing frequency. As a palliative measure it is believed to protect against tumor spread during operation and/or biopsy. With curative doses it is expected to cause regression of the primary tumor and of local metastatic lesions. A late skin reaction may, however, delay operation for several months, and this has proved to be a distinct disadvantage. Further disadvantages are prolonged exertion and anxiety which have an unfavorable effect on the patient's general condition and on the body's defense mechanism. Too much suffering may also result in the patient's refusal of the operation, especially when tumor regression has been achieved with roentgen rays.

As a compromise procedure the author has expedited roentgen therapy by shortening the interval between treatments and, correspondingly, decreasing the dose at individual treatments. He uses four fields (two tangential, one axillary and one supraclavicular), delivering 100 r per field twice daily, seven days per week, for a total of fifteen days or 3,000 r per field. Mastectomy follows on the sixteenth day, which is long before the peak of the skin reaction. The latter is usually seen from the twenty-sixth to the thirtieth day, at a time when healing of the operative wound has made considerable progress.

Twenty cases have so far been treated by this method with an average hospitalization of seven weeks. Since the day of operation is predetermined, the patient's anxiety is greatly diminished. Thus, refusal of the operation has not occurred so far. A certain disadvantage of the rapid method is a delay of wound healing in some cases.

ERNEST KRAFT, M.D.
Northport, N. Y.

Approximation Technique in Treatment of Cancer of the Cervix with Irradiation. Charles L. Martin. Am. J. Roentgenol. **77**: 388–396, March 1957. (3501 Gaston Ave., Dallas 4, Texas)

The author describes his method of treatment of cancer of the cervix, gives statistics, and compares his results with those of Liu and Meigs who employ radical surgery. Although some external roentgen therapy is given, the most important part of the procedure consists in the use of small radium sources so placed that no portion of the tumor receives less than 6,000 gamma roentgens in seven days.

If the primary lesion is small and definitely localized to the cervix, with little or no evidence of extension, a multiple capsule technic is employed. First, a heavily filtered capsule containing two 25-mg. sources of radium is placed in the cervical canal for about thirty hours. On the day following its removal, 25-mg. London spools are placed well out in the vaginal vault for a period of twenty-four to twenty-eight hours. Following this, 50 mg. of radium divided into two or more units are placed in accurate contact with the visible lesion on the face of the cervix for twenty-four hours. This entire procedure, which delivers a large dose well beyond the demonstrable tumor, is carried out in a period of a week. Radium therapy is supplemented by external irradiation—600 r in air to each of four portals, 15 × 15 cm.—with standard 220-kv equipment (0.5 mm. Cu plus 1.0 mm. Al filtration; skin-target distance 80 cm.). The roentgen treatments are given between radium applications so that the patient is able to leave the hospital at the end of a week. Local recurrences are practically never observed, and deep-seated recurrences can be treated with external radiation as a palliative procedure if they appear at a later date. Complications are practically nil.

For larger lesions, or, if invasion of the neighboring structures is detected, a different technic is used, employing long, low-intensity radium needles varying in length from 1.5 to 5.0 cm., with a loading of 0.66 to 0.88 mg. per cm. The dosage is roughly calculated, and practice enables good approximation. This is followed by 220-kv x-ray irradiation through 13 × 15-cm. portals, each of which receives 1,200 r. The x-ray therapy may be repeated at six- to eight-week intervals until two or three series have been given. Improvement is invariable and cures are common.

For 78 cases of invasive carcinoma of the cervix seen in 1948 and 1949 and adequately treated, the five-year cure rate was 55.1 per cent. The rates by Stages are: Stages I and II (54 cases), 72.2 per cent; Stage III (11 cases), 27.2 per cent; Stage IV (13 cases) 7.6 per cent. Liu and Meigs (Am. J. Obst. & Gynec. **69**: 1, 1955) reported a five-year cure rate of 69 per cent for 165 Stage I and II cases. There was a higher incidence of serious postoperative complications in the surgically treated cases than in the cases treated by irradiation. There were practically no complications with irradiation.

Eight roentgenograms; 5 diagrams; 2 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

Observations on the Postoperative Irradiation of Carcinoma of the Uterine Cervix. Alexander Vonessen. Strahlentherapie **102**: 448–450, March 1957. (In German) (Strahlenabteilung der Städt. Krankenanstalten Koblenz, West Germany)

This article is based on an experience with 158 cases of cervical carcinoma, treated postoperatively over a period of ten years (1947–1956). In 60 of these cases there was tumor tissue in the scar prior to radiation therapy. This development was due either to delayed referral to the radiologist or to neglect on the part of the patient. Tumor tissue found during the first postoperative year was arbitrarily considered residual neoplasm. Thereafter it was interpreted as a recurrence. In the group of 60 cases, 70 per cent showed residual tumor and 30 per cent recurrence.

Radiation therapy was started at an average of ten weeks postoperatively; but the interval varied from two weeks to as much as four years. Ninety-six patients could be followed for five years and longer. Thirty-six of these had residual tumor or recurrence, initially.

Cases without recurrence had prophylactic roentgen therapy in three separate series. The area under treatment included the entire small pelvis. Cases with recurrence had combination roentgen-ray and radium therapy, with a modified Stockholm technic, during a period of six to eight weeks. The dose at the surface of the tumor was 15,000 r, at the parametria it was 2,500 r.

Among 60 cases without residue or recurrence initially, there were 40 five-year survivals. Of 21 patients with initial residue or recurrence, only 11 survived five years. Of 15 with parametrial spread in the beginning, only 1 survived the five-year period.

From the statistical data, it is concluded that indications for hysterectomy have not been sufficiently conservative. It is recommended that irradiation be instituted no later than three weeks postoperatively.

One table.

ERNEST KRAFT, M.D.
Northport, N. Y.

The Prognostic Value of End-of-Treatment Biopsies in Treatment of Cancer of the Cervix. Robert E. Fricke and Malcolm B. Dockerty. Am. J. Roentgenol. **77**: 448–451, March 1957. (Mayo Clinic, Rochester, Minn.)

The authors review results of end-of-treatment biopsies in 175 unselected cases seen during the period 1951–54. This study was undertaken in an attempt to determine the presence of radioresistance during the treatment of cancer of the cervix and to gain some idea of prognosis.

Biopsy of the healing cervix was done at the last radium insertion at the end of four weeks of treatment. Of the 175, 146 were negative for carcinoma, 29 were positive. In the negative group, 24 per cent were later found to have recurrence or residual carcinoma and might be considered radioresistant. Of the 29 cases with positive end-of-treatment biopsies, 62 per cent were apparently radioresistant, with recurrence or extension of the cancer. The conclusion is drawn that, although the end-of-treatment biopsy is a poor guide, it offers some help in prognosis.

Six photomicrographs.

NORMAN L. ARNETT, M.D.
Upland, Calif.

Results of Treatment of Primary Ovarian Malignancy. D. Nelson Henderson and John L. Bean. Am. J. Obst. & Gynec. **73**: 657–661, March 1957. (University of Toronto School of Medicine, Toronto, Ontario, Canada)

A critical review of 336 cases of primary ovarian cancer treated from 1936 to 1952 is presented. Restudy of the pathological diagnoses was done to exclude papillary tumors of doubtful histologic malignancy; 6 cases of

the pseudomucinous group associated with pseudomyxoma peritonei were excluded. Included are 2 solid malignant teratomas, 20 granulosa-cell tumors, 9 dysgerminomas, 2 arrhenoblastomas, the remainder consisting of malignant papillary cystic tumors, papillary solid tumors, solid adenocarcinomas, and malignant pseudomucinous neoplasms.

The group consists of 110 favorable cases (complete removal of the primary and all evident secondary tumor) and 195 unfavorable cases (incomplete removal of the evident tumor or with biopsy only). The overall five-year survival rate was 18.1 per cent; for the favorable cases it was 34.2 per cent as compared with 7 per cent for the unfavorable cases. With granulosa-cell tumors and dysgerminomas the survival rate was approximately 50 per cent; both patients with arrhenoblastomas survived. In the favorable cases treated by oophorectomy alone, the survival rate was 33.3 per cent as compared with 52.6 per cent with bilateral oophorectomy and hysterectomy.

An unstated amount of high-voltage x-ray therapy was given in practically all cases postoperatively. In the authors' experience the cystic papillary adenocarcinoma responds more favorably to radiation than the solid adenocarcinoma; the pseudomucinous carcinoma is particularly radioresistant. The granulosa-cell tumor and dysgerminoma are not particularly radiosensitive.

Intraperitoneal radioactive gold is not routinely employed postoperatively but its use, either alone or as an adjunct to high-voltage treatment, is suggested as a possible means of improving the survival rate in the favorable cases.

Six tables.

ROBERT L. EGAN, M.D.
University of Texas, Houston

Results of Irradiation Treatment of Tumors of the Urinary Bladder. H. R. Schinz. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 363–373, March 1957. (In German) (Radiotherapeutische Klinik des Kantonsspitals Zürich, Zürich, Switzerland)

The author reviews 121 cases of urinary bladder tumors that had been irradiated. Papillomata and noninfiltrating, superficial carcinomas were treated with liquid radiocobalt, while the deeply penetrating carcinomas were treated with the 31-MEV betatron.

Radioactive cobalt (Co^{60}) is obtained in metallic form. It is dissolved in hydrochloric acid and a 23 per cent solution of sodium iodide is added to make it radiopaque for x-ray visualization and control of localization. A double-barreled Bardex catheter is introduced into the bladder under local anesthesia. The cobalt is injected through one of the barrels into the balloon, while the other barrel is used to drain the urine continuously, thus allowing close approximation of the bladder wall to the balloon. About 18 to 25 mc of Co^{60} is used, producing about 800 to 1,300 r per twenty-four hours or 10,000 to 12,000 r in eight to ten days. The patients must occupy private rooms because at a distance of 2.5 meters the stray radiation amounts to more than the daily tolerance dose of 50 milliroentgens. For the care of the patients, only elderly nurses are used. The urine is examined for radioactivity daily to make sure that there is no leakage. Most of the patients develop a rather severe cystitis following the irradiation.

Of 17 patients with benign or relatively benign papillomata 4 were seen too recently to be of statistical value and 4 are dead; 9 are alive, 5 of them more than four years. Statistical data are available on 65 patients with definitely malignant papilloma, or superficial bladder carcinoma. Twenty-eight are alive, some of them seven and eight years after irradiation.

The infiltrating deep carcinomas were treated with the betatron and the results were quite gratifying. Of 29 patients, 10 are alive, but 1 of them has a recurrence. The treatment plan is as follows: A tumor dose of about 6,000 r is given in daily increments of 100 r through an anteroposterior and a postero-anterior field. In case of recurrence another series of 4,000 to 6,000 r may be given after three months. Betatron therapy has been so easy on the patient and the results are so gratifying that the author has decided to treat the superficial cancer cases from now on with this technic rather than with cobalt.

Nineteen figures.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

The Treatment of Recurrent Carcinoma of the Rectum by Supervoltage X-Ray Therapy. Ivor G. Williams, Ivor M. Shulman, and Ian P. Todd. Brit. J. Surg. **44:** 506–508, March 1957.

The authors treated 82 cases of adenocarcinoma of the rectum, recurrent after surgery, with 1,000 kv x-rays. With early, small, localized recurrences an attempt at radical cure was made, with a planned tumor dose of 6,000 r in six weeks. In a few cases this could not be achieved due to severe skin reaction in groins and perineum. Treatment was sometimes interrupted for enteritis, colitis, or cystitis. Cases with widespread local recurrence or with metastases received palliative doses of 3,000 to 4,000 r in three to four weeks. Typical fields were 2 anterior oblique, 2 posterior oblique, and a direct posterior. Three patients suffered more than the expected skin reaction (2 radionecrosis and 1 radiodermatitis).

Symptoms were relieved in 71 of the 82 cases. In 41 of these the relief lasted more than three months. Four patients are well three or more years after treatment, and 4 others twelve to thirty-two months after treatment.

Pain following surgery for carcinoma of the rectum usually means recurrence. The authors recommend prompt supervoltage x-ray treatment at this stage. In view of the occasional five-year cures by radiation, it might be of value postoperatively where there is extensive local spread or the surgeon is not satisfied with the excision.

Three tables.

CAPT. GARTH R. DREWRY
MacDill AFB, Fla.

Spontaneous Regression (Cure?) of a Malignant Tumor of Bone. Emanuel J. Levin. Cancer **10:** 377–381, March–April 1957. (Department of Radiology, Maimonides Hospital, Brooklyn 19, N. Y.)

Everson and Cole (Ann. Surg. **144:** 366, 1956) were able to find only 47 cases of spontaneous cure or regression of a malignant tumor that satisfied their prerequisite of biopsy confirmation by a competent pathologist and no significant therapy. The author reports another case which meets these criteria.

The patient, a 29-year-old woman, was seen in 1952 with swelling and deformity of the left arm. Roentgenography showed extensive "moth-eaten" destructive changes involving the humerus from the surgical neck midway down the shaft. There was a pathological-

fracture with lateral angulation, but no evidence of callus formation, periosteal proliferation, or "tumor bone." A biopsy was obtained and a histologic diagnosis of osteogenic sarcoma was considered most likely, although the possibility of a malignant giant-cell tumor could not be excluded. All forms of definitive treatment were refused. In 1955 the patient was seen again; at that time she was in excellent health, without a complaint. The skin over the left humerus was the same color and texture as that over the right, showing only the biopsy scar. A roentgenogram revealed complete healing of the humerus, except for residual slight deformity and sclerosis. A complete roentgenologic survey in May 1956 disclosed no abnormality.

Three roentgenograms; 3 photomicrographs.

Device for Providing Uniform Radiation in Radiotherapy. Leopoldo Vernazza. Radiol. clin. **26:** 98–111, March 1957. (In English) (Via Taglio 38, Modena, Italy)

The author presents theoretical and practical considerations in respect to achieving homogeneity of radiation. Such equalization is accomplished by cutting down the time of radiation in those areas receiving the larger doses. This is done by periodic interruptions of the radiation by means of a rotating lead disk which successfully interrupts irradiation for the time necessary to achieve homogeneity.

Two drawings. CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

A Convenient Shield for X-Ray Therapy About the Head. Herbert J. Bernhardt. Arch. Dermat. **75:** 265, February 1957. (821 Franklin Ave., Garden City, N. J.)

The author has devised a shield which he has found helpful in superficial x-ray therapy of benign lesions of the face. This shield will not slip and completely protects the ears and hair-bearing areas. It is cut from a single sheet of lead foil in a pattern shown in an accompanying diagram. Several seconds are all that are necessary for the correct placement of the shield.

Two illustrations.

Measurement of the Spectral Distribution of Scattered 400 kvp X Rays in a Water Phantom. D. V. Cormack, T. J. Griffith, and H. E. Johns. Brit. J. Radiol. **30:** 129–135, March 1957. (Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan, Canada)

A scintillation counter employing a large sodium iodide crystal has been used to measure the spectral distribution of the scattered radiation in a water phantom irradiated with 400-kvp x-rays. The spectrum was determined at various points along the central axis of the x-ray beam for different scattering angles. The complete energy spectrum at each point was found by integrating over all angles. The shape of the spectral distribution of the scattered radiation was found to be nearly independent of the depth below the surface of the phantom. The variation of spectral distribution with field size was also investigated and in this case, too, the shape of the distribution was very nearly constant but was somewhat shifted to lower energies as the area of the field was increased. The scattered spectra were also plotted as distributions of dose and then combined with the dose distributions of primary radiation to give the total dose distribution. As an illustration of the use of radiation spectra, these dose distributions were employed to calculate the effective half-value layer in copper and the average linear energy transfer of the radiation at various depths and for various field sizes. In addition, the absorbed dose in bone compared to the dose in muscle was calculated from the spectral distributions.

Nine figures; 3 tables.

RADIOISOTOPES

The Role of Radioactive Isotopes in Carcinoma of the Maxillary Antrum. Arthur G. James. Am. J. Roentgenol. **77:** 415–420, March 1957. (University Hospital, Ohio State University Medical Center, Columbus, Ohio)

Cancer occurs more frequently in the maxillary antrum than in any of the other paranasal sinuses, but antral carcinoma is still a rare disease. It is usually detected late, often after destruction of bone has occurred. The symptoms are pain, swelling, nasal obstruction, nasal bleeding, and sepsis. Invasion of the orbit with displacement of the eye or unilateral exophthalmos is a late feature. The disease occurs in males twice to four times as frequently as in females and is seen most commonly after the age of forty. Diagnosis is aided by roentgenograms, which reveal bony destruction and aid in defining a mass protruding into the nasopharynx, orbit, or skull.

Treatment is primarily surgical, consisting of radical resection of as much tumor-bearing tissue as possible. If the eye is involved, it must be sacrificed. Radiation therapy is given if the tumor has not been completely removed, or if the margin of excision is not considered sufficiently wide. As soon as healing is sufficient, which is usually within the first few postoperative days, a sponge rubber prosthesis or a plaster mold is placed in the surgical cavity. The surface of the mold is im, planted with one of the radioactive isotopes, cobalt 60-gold 198, or iridium 192. Cobalt 60 has a half life of 5.13 years, and it is a gamma irradiator of approximately 1.3 million volts. Gold 198 has a half life of 2.7 days and is a gamma irradiator of about 0.4 million volts. Iridium 192 has a half-life of 72 days, and is a gamma irradiator of 0.3 million volts. The isotopes are easy to handle when they are supplied in the form of metallic wires that can be loaded into flexible nylon applicators, and do not require heavy shielding, as does radium.

It is hoped that this method of therapy will completely eradicate cancer of the maxillary antrum, with fewer complications and an increase in the survival rate. No statistics of survival are furnished. One case is reported.

Three roentgenograms; 4 photographs; 3 drawings.
PAUL MASSIK, M.D.
Quincy, Mass.

Simplified Radioactive Iodine Therapy. Alastair G. Macgregor. Brit. M. J. **1:** 492–495, March 2, 1957. (University of Edinburgh, Edinburgh, Scotland)

Whenever an attempt is made to administer a precise and predetermined dose of radiation to the thyroid

gland, the therapist must make a number of assumptions the validity of which is doubtful. Some of these assumptions include: The dose of radiation is delivered uniformly throughout the gland; metabolism of I^{131} is similar following both tracer and therapeutic doses; biological response to a given dose of radiation is constant and predictable; effective half-life of the isotope, mass of the gland, and peak percentage uptake can all be accurately determined.

Because the precise determination of dosage is a time-consuming and exacting procedure, and because many of the assumptions listed above are open to question, the author decided to try a simple and arbitrary dosage schedule for treatment of thyrotoxicosis with I^{131} and to compare the results with those obtained with more exacting dosage methods.

All patients were given a preliminary tracer dose of radioactive iodine to confirm the diagnosis and to insure the fact that the thyroid is able to absorb a high proportion of the administered dose. A therapeutic dose of I^{131} was then given on an arbitrary basis as follows: Patients with small glands received 4 millicuries by mouth when the thyroid was impalpable, and 5 or 6 millicuries for minimal enlargement. Large nodular glands received doses up to 15 millicuries. Normally no preliminary treatment directed to the thyroid was given. In patients with dangerous degrees of toxicity a short course of potassium iodide, 60 mg. daily, was given, starting not earlier than one week after the therapeutic I^{131} had been administered. Patients were followed at about six-week intervals after therapy. If no clinical improvement was evident in six to ten weeks, the patient was restudied with tracer dose investigation and further therapeutic iodine.

One hundred fifty consecutive patients treated according to the above schedule and followed for a minimum period of more than one year are analyzed. Eighty-seven per cent were euthyroid, 2 per cent were still toxic to some degree, and 11 per cent were hypothyroid. Fifty-nine per cent of these patients were rendered euthyroid after a single dose of radioactive iodine and 9 per cent became myxedematous following the first dose. Approximately one-third of the patients required more than one dose, but in almost all good results were obtained.

Comparison with other reported series, some of which utilized exacting predetermined dose methods, showed that the simple method here reported gives as good results. Comments are made on the relative economies effected by isotope therapy as compared to long term medical management of other types and surgical methods.

It is concluded that elaborate technics for the calculation and administration of I^{131} are unnecessary for the safe and effective treatment of thyrotoxic patients in the great majority of cases.

One graph; 2 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Radioactive Iodine in the Treatment of Thyreopathies. G. M. Ferraris, F. Marocco, and F. Cottino. Radiol. med., Milan **43:** 274–299, March 1957. (In Italian) (Ospedale Mauriziano, Turin, Italy)

This study is based on the treatment with radioactive iodine of 118 hyperthyroid patients (followed up to March 1956): 66 of them were "clinically cured" for a period of six months or longer, 14 were noticeably improved for six months or longer, 12 showed little or no improvement, 20 were still under treatment, 3 could not be traced, 2 had died (from cardiopathies, decompensated prior to therapy), and one underwent surgery because of suspicion of malignancy. The doses of I^{131} varied between 3 and 35 mc, the median being 14.6 mc. In rep, the estimates ranged between 300,000 and 2,200,000, the median being 837,000 rep.

Radioactive iodine therapy is electively indicated in older persons, in long-standing processes, in patients who refuse surgery (when surgery appears indicated), and when thiouracil is temporarily or permanently ineffective. It is indicated even in young females in whom thiouracil has caused excessive tumefaction of the thyroid or other toxic phenomena (alopecia, icterus, rheumatalgia). In the presence of toxic symptoms of hyperthyroidism (threatening exophthalmos, psychotic, neuromuscular, hepatic, or cardiovascular episodes), iodine appears indicated regardless of age. A nodular goiter should be removed surgically, not only as a precautionary measure because of possible malignancy, but also in view of the high dosages required for adequate results in such cases. On the other hand, I^{131} may be given prior to surgery, as its use will avoid the hyperemia and parenchymal fragility encountered after thiouracil.

The initial dose of radioiodine may be anywhere from 5 to 25 mc. A lower dose is given for smaller goiters, younger patients, toxic forms, recently developed disease, and when neuropsychiatric disturbances are present. Higher doses are reserved for large and/or nodular goiters, older patients, and long-standing disease. Subsequent doses may be given during the third month —never prior to the end of the second month—after administration of the first dose. (Incidentally, unintentional overdosage of I^{131} can be corrected by administering a large amount of I^{127}, which will then replace the radioisotope from the gland.)

Several weeks or even months must elapse prior to the evaluation of therapeutic effects. There are cases which show resistance toward radioiodine, and occasionally large doses of I^{131} are necessary to influence thyroid function, in which case the threat of ultimate hypothyroidism becomes obvious. In point of fact, at times hypothyroidism may occur after a long delay (years ?), and/or after relatively small doses of radioiodine. The true incidence of this complication will have to be determined by long-term follow-up studies. At the present state of our knowledge, the preliminary calculation of the amount of radioisotope to be administered to a given patient for best results is still far from the desired accuracy, and must therefore be determined by correlation with clinical and other circumstances.

Five graphs; 19 tables.

IRWIN F. HUMMON, M.D.
Cook County Hospital

Defective Organic Binding of Iodine by the Thyroid in Hashimoto's Thyroiditis. M. E. Morgans and W. R. Trotter. Lancet **1:** 553–555, March 16, 1957. (University College Hospital Medical School, London, England)

An investigation of the organic binding of iodine by the thyroid in 26 patients with simple goiter and in 12 with Hashimoto's thyroiditis is described. The cases classed as simple goiter included some patients with diffuse and some with nodular glands, with normal thyroid function. Six of the patients believed to have Hashimoto's thyroiditis had undergone thyroidectomy, and

histologic sections confirmed the diagnosis. Four of the remainder had positive serum-flocculation tests and raised serum-gamma-globulin levels. One patient had clear signs of myxedema, with a small firm diffuse goiter, and another had a fairly large firm diffuse goiter which disappeared after x-ray therapy, with the simultaneous development of symptoms of myxedema.

The patients came for their tests at least five hours after the last meal. Twenty to 40 μc of I^{131} was given by mouth, and fifty and sixty minutes later counts were made simultaneously over the thyroid and thigh regions with a standard Geiger counter. Immediately after the sixty-minute count, the patients drank a solution of potassium perchlorate containing either 200 mg. or 400 mg. with 25 or 50 ml. of water, respectively, and the counting-rate opposite the neck and thigh was measured again at ten, twenty, thirty, and forty minutes.

When potassium perchlorate is given to normal subjects one hour after a tracer dose of I^{131}, the thyroid counting-rate rises slightly and then remains constant. This is taken to mean that, by this time, almost all the labeled iodine in the gland is organically bound. The 25 patients with simple goiter reacted in the same way. In the 12 cases of Hashimoto's thyroiditis there was a significant tendency for radioiodine to be discharged from the thyroid after the administration of perchlorate. These observations are taken to indicate that an appreciable proportion of the administered I^{131} was still present in the thyroid in the form of iodide at the time the perchlorate was given. This is presumptive evidence of a partial defect in the organic binding of iodine by the thyroid in Hashimoto's thyroiditis.

Five charts.

The Use of I^{131}-Labeled Albumin in the Diagnosis of Pancreatic Disease. Robert J. Freeark, Donald D. Kozoll, and Karl A. Meyer. Surgery **41:** 268–275, February 1957. (Cook County Hospital, Chicago 12, Ill.)

In 1952, Lavik, Chinn, and co-workers introduced a test for pancreatic insufficiency which utilized a meal of I^{131}-labeled protein. (Pediatrics **10:** 667, 1952; New England J. Med. **247:** 877, 1952. Abst. in Radiology **61:** 469 and 697, 1953). That an individual's ability to digest and absorb such a protein is a measure of pancreatic function has been well established by these authors and also by Shingleton and his associates (Surgery **38:** 134, 1955. Abst. in Radiology **66:** 926, 1956). Previous tests have shown that less than 5 per cent of the I^{131} is released from the albumin molecule by other means than protein breakdown. The present study is an attempt to evaluate the sensitivity and practical value of this test in patients with various forms of pancreatic disease. The technic of the test is described in the abstracts of the earlier articles.

It was found that a normal individual will show a peak concentration of I^{131} in the blood at two or three hours with a gradual return to the isotope-free state; the peak level may vary from 10 to 22 per cent, but in no instance did the normal controls show peak concentrations below 10 per cent of the isotope ingested. Special controls, with nonpancreatic diarrhea, were generally at the lower limits of normal, but at no time fell below 10 per cent at peak concentration.

Nine cases of pancreatic insufficiency showed much flatter curves with peak levels above 5 per cent in only 1 instance; the remainder of isotope concentrations were generally below 4 per cent.

Thirty cases of obstructive jaundice were studied. In 6 of the 8 cases of obstructive jaundice due to carcinoma of the head of the pancreas, there was definite evidence of pancreatic insufficiency; in the remaining 2, protein digestion was similar to that in normal individuals. In 22 cases of nonpancreatic obstructive jaundice, only 1 showed abnormal protein digestion preoperatively. The value of the test in the differential diagnosis of obstructive jaundice is readily apparent, in that a flat curve indicates simultaneous pancreatic and common duct obstruction and is strongly suggestive of pancreatic carcinoma.

Six patients with pancreatic cyst, 6 with acute pancreatitis without evidence of pancreatic insufficiency, and 4 with carcinoma of the body and tail of the pancreas showed no significant difference from the normal controls.

In 4 of 5 patients with pancreatic calculi, an abnormal protein digestion was observed, although diarrhea was present clinically in only 3 of the 4 abnormal patients at the time of the examination.

The authors believe the test is of particular diagnostic value in the study of patients with diarrhea of undetermined origin and in cases of obstructive jaundice. It is a simple means of confirming the diagnosis of pancreatic insufficiency. There are no reliable laboratory procedures for the diagnosis of localized disease unassociated with pancreatic duct obstruction.

Three figures.

Cobalt Radiotherapy: Two Years' Experience in a Private Office. Sanfurd G. Bluestein. J. M. Soc. New Jersey **54:** 120–122, March 1957. (591 E. 27th St., Paterson 4, N. J.)

On the basis of two years experience with cobalt radiotherapy, the author believes it is superior to conventional roentgen therapy in the management of cancer because higher doses can be achieved, radiation sickness is less, skin reactions are diminished, palliation is enhanced, and cure rates may be increased. Ten case reports of cure or palliation are given in detail. In all instances there was prolongation of life and alleviation of symptoms.

The Use of Interstitial Radioactive Cobalt Needles in the Treatment of Carcinoma of the Cervix. Harry E. Ezell and John H. Holzaepfel. Am. J. Obst. & Gynec. **73:** 354–358, February 1957. (Ohio State University College of Medicine, Columbus 10, Ohio)

Ninety-nine patients with cervical carcinoma treated with radioactive cobalt needles loaned themselves to a five-year follow-up. A single patient was untraced.

Stainless steel-jacketed needles containing the radioactive cobalt were thrust through previously drilled holes in a Lucite template which fitted into the vagina. As shown in the illustrations, three to six needles formed a cylindrical volume implant for the cervix and six to ten needles were directed into each parametrial area. Differential loading compensated for the divergence of the needles. A dose of 6,000 to 7,000 tissue roentgens was then delivered. This completed the irradiation in Stages I and IV, but in Stages II and III an additional 2,000 r to a 20 × 20-cm. anterior and posterior port were given.

The five-year survivals were as follows: in Stage I, 2 of 3 patients; in Stage II, 17 of 35; in Stage III, 13 of 50; in Stage IV, 1 of 11 patients.

In 43 of the 99 cases radiation proctitis developed

to the extent of gross rectal bleeding. Severe complications included 11 rectovaginal fistulas, 6 vesicovaginal fistulas, 11 large bowel obstructions, and 1 small bowel obstruction. Two patients with large bowel obstruction refused colostomy and died.

The authors offer no comment on the comparative value of this method of interstitial irradiation.

[At M. D. Anderson Hospital, University of Texas, Co^{60} needles have been abandoned altogether, even for plane molds].—R. L. E.

One figure, 1 roentgenogram, 4 tables.

RORERT L. EGAN, M.D.
University of Texas, Houston

Treatment of Cancer of Prostate by Interstitial Injection of Au 198: Studies in Problem of Distribution. R. H. Flocks, H. B. Elkins, and D. Culp. J. Urol. **77:** 505–520, March 1957. (College of Medicine, State University of Iowa, Iowa City, Iowa)

Three hundred and eighty-nine patients with inoperable cancer of the prostate have been treated by the authors with interstitially injected Au^{198}. Selection of patients was based on the presence of locally extensive tumor without distant metastases or locally operable lesions in patients whose general condition did not permit surgery or who refused operation.

The objective of treatment was to destroy not only the local lesion but also neoplasm in the adjacent fasciae and in the regional lymphatic channels and lymph nodes. It has been demonstrated that 1 to 1.5 mc of Au^{198} per cubic centimeter of tissue will achieve a cancerocidal effect. The problem appears to have been largely one of distribution.

Animal experiments and *in vitro* trials with hyaluronidase indicate that it should enhance distribution but the authors have not tried it on any patients. They doubt the theoretical objection that it might cause the material to leave the prostate sooner.

The average prostate with its cancer holds only 2 to 3 c.c., so that a small amount of highly concentrated Au^{198} must be used (activity of 25 to 30 millicuries/c.c.). If larger volumes are injected the fascial planes will be torn, causing the material to be directed toward the rectum first and then to other areas of the pelvis. In the authors' early cases 25 to 50 c.c. were used, resulting in a high incidence of rectal damage. An aid in checking on distribution is the addition of pyelographic medium to the diluent for roentgenography.

The best approach is a combined transvesical and extraprostatic one, guided by the fundamental principle of putting multiple small volumes of the isotope throughout each compartment of the gland. Bulky nodes and tumor tissue are removed first to reduce the amount of radioactive substance required. Secondary injections at two-month intervals are quite safe and may be effective if biopsy still shows living tumor.

Thirty-five figures; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Further Experiences in Treatment of Carcinoma of Prostate with Radioactive Chromic Phosphate and Yttrium Chloride. George J. Bulkley, Vincent J. O'Conor, and John A. D. Cooper. J. Urol. **77:** 497–504, March 1957. (720 N. Michigan Ave., Chicago 11, Ill.)

Disappointing results are reported from the use of radioactive yttrium chloride and chromic phosphate for prostatic carcinoma in spite of their theoretical advantages of good tissue fixation and high energy beta radiation.

Radioactive yttrium chloride was used in 12 patients, but only 2 showed any improvement. No complications were seen but the loss into the blood and urine was as great as with radioactive gold or chromic phosphate.

Radioactive chromic phosphate was injected into 5 prostatic carcinomas and 4 of the patients showed serious bone marrow depression. Two of these died, at least partly from the bone marrow effects. None showed any clinical improvement.

It is concluded that radioactive chromic phosphate should not be used for interstitial injection of prostatic carcinoma and that radioactive yttrium chloride has no advantage over gold, while being much harder to obtain.

Three graphs; 2 tables.

ZAC F. ENDRESS, M.D
Pontiac, Mich.

A Scanning Apparatus for the Localization of Gamma Emitting Isotopes in Vivo. Lars Jonsson, Lars-Gunnar Larsson, and Inger Ragnhult. Acta radiol. **47:** 217–228, March 1957. (Radiumhemmet, Stockholm, Sweden)

A motor-driven directional scintillation counter with automatic recording for the localization of gamma emitting radioisotope *in vivo* is described. This device was designed at Radiumhemmet, Stockholm. In particular, it was constructed to meet the clinical demands which appeared during radioiodine studies of the thyroid gland and thyroid carcinomas; and in connection with the intravenous, intracavitary, and interstitial use of radioactive colloids.

The scintillographic technic has at present its greatest practical importance in connection with radioiodine studies of the thyroid gland. The localization and the shape of the active gland can be observed and its size determined, the latter being of special importance for the dosimetry in radioiodine therapy. The function of nodules within the gland may be studied, and ectopic thyroid tissue, as lingual, prelaryngeal, and intrathoracic goiters may be diagnosed. Minor remnants of thyroid tissue after thyroidectomy or I^{131} ablation, not possible to diagnose by conventional uptake studies and easily overlooked during manual directional measurements, may be localized and mapped out. Metastases from functioning thyroid carcinoma may be diagnosed and studied. For this purpose, a scintillograph which can scan large areas of the body is especially useful.

Ten figures.

RITA M. BRADY, M.D.
University of California, S. F.

Estimation of Exchangeable Water and Potassium by Radioisotope Dilution in Children. J. A. James and J. S. Robertson. J. Dis. Child. **93:** 217–222, March 1957. (J. A. J., Department of Pediatrics, The University of Texas, Southwestern Medical School, Dallas 19, Texas)

The advent of liquid-phase scintillators has simplified the counting of low-energy beta particles enabling tritium water (HTO) samples to be counted rapidly and accurately. With this in mind the authors set out (*a*) to study the kinetics of mixing, volume of distribution, and biological decay of HTO (tritiated water) in children; (*b*) to compare values for total body water obtained by a simple technic to prepare HTO samples, with those of another method, namely, antipyrine; (*c*) to

relate body water and exchangeable potassium content. Though the 9 children studied, ranging in age from thirty to one hundred two months, were hospitalized at, or recently discharged from, the Nephrotic Unit of the Brookhaven National Laboratory Medical Center, and had proteinuria, the authors felt that since there was no edema and the plasma proteins were near normal the results were valid.

With careful technic 10 ml. of a mixture containing 3 mc/kg. of K^{42}, 75 mc/kg. of HTO, and 400 mg. of antipyrine were injected. A similar volume of the same mixture was placed in a flask from the same syringe for dilution as a standard for all three substances. Subsequent blood and urine samples were collected with great care. It is interesting to note that the irradiation from K^{42} is about 140 and from HTO about 160 millirads at the dosages used. These add up to the integrated permissible radiation dose for eight days.

By the tritium method, the average of the total body water, by weight, was 55.1 per cent and with antipyrine 56.3 per cent. In terms of surface area, HTO and antipyrine gave total body water volumes of 15.1 and 15.4 liters/sq. meter respectively.

Exchangeable potassium (E_k) was measured in 7 of the 9 patients and averaged 44.1 mM/kg. This corresponds roughly to 80 mM/L of total body water. If the intracellular fluid constitutes two-thirds of the total body water the E_K would be about 120 mM/L.

There is apparently rapid equilibration of the injected HTO throughout the body tissues, thorough mixing occurring within thirty to forty minutes. The half-time varied from 3.7 to 8.0 days indicating a turnover of body water of from 8.7 to 18.7 per cent. Tritium excretion appears to occur along an exponential curve with detectable amounts still present in the urine at twelve days.

The advantages of using HTO rather than antipyrine (or deuterium oxide) as a tracer material are that it mixes readily with abnormal fluid collections, permits the study of urine specific activities, distribution kinetics, and turnover rates.

The data obtained confirm the fact that total body water measurements are of little clinical value at this time, due to the wide range of normal values as well as to unexplained variations in serial determinations. However, it does point up the fact that the exchangeable water in a child averages about twice that of an adult, thus making children much more susceptible to water depletion.

SAUL SCHEFF, M.D.
Boston, Mass.

Pituitary Necrosis Due to Implants of Radioactive Gold and Yttrium. Stretton Young. Lancet **1**: 548–551, March 16, 1957. (Clinico-Pathological Laboratories, Imperial Cancer Research Fund, London, England)

Pituitary glands were obtained at autopsy from 14 patients who had been treated by radioactive pituitary implants for mammary or prostatic carcinoma. The glands were fixed in Helly's fluid or in cold formol saline solution followed by secondary fixation in Helly's fluid. Drawings were made of the shape of the gland and of the position and orientation of any visible implants. The implants were then removed and the tissue trimmed so that the plane of the section would cross the axis of the implant at right angles. Three types of radioactive material had been used: (1) Radiogold grains, cylindrical in shape, measuring 0.8 × 2.5 mm., with a nonradioactive screen of platinum (0.1 mm.) which reduces the beta irradiation. (2) Radiogold grains, cylindrical in shape and measuring 0.8 × 5 mm. No platinum screen was present; thus the ratio of beta to gamma irradiation was considerably greater than in the screened variety. (3) Yttrium-oxide pellets, cylindrical in shape and measuring 1.3 × 3.95 mm. These emit beta irradiation. In 6 of the 9 cases treated with radioactive gold, the dose of gamma radiation to the periphery of the necrotic area lay between 68,000 and 93,000 gamma r.

The author found that in this series of cases implants of radiogold and yttrium did not cause complete necrosis of the pituitary. A minimum of about 70,000 r of gamma radiation appears to be necessary to produce necrosis in most parts of the gland. Cells adjacent to the capsule and those around blood vessels were more resistant to radionecrosis than were those elsewhere. Chromophobe, eosinophil, and basophil cells seem to be equally susceptible to the necrosing effects of gamma and beta irradiation. On the basis of absence of mitotic activity in apparently undamaged areas of the pituitary, there was no evidence of regeneration.

Ten drawings; 3 photomicrographs; 3 tables.

Comparison of the Inhibition of Goitrogenesis in the Rat Produced by X Rays and Radioactive Iodine. John D. Abbatt, I. Doniach, P. Howard-Flanders, and J. H. Logothetopoulos. Brit. J. Radiol. **30**: 86–88, February 1957. (Hammersmith Hospital, London, W. 12, England)

The authors point out that most assessments of radiation damage to the thyroid are based on tests for the presence or absence of hypothyroidism. The thyroid shows an unusual ability to overcome the loss of major portions—by whatever cause—through compensatory hypertrophy. Two of the authors previously had found an index of radiation that was sensitive and easily measurable (Brit. J. Cancer **9**: 117, 1955). Following thyroid irradiation, they observed a reduced response to a standard goitrogenic stimulus, propylthiouracil.

This paper records the results of an experiment to find the dose of external thyroid irradiation necessary to produce an equal degree of goitrogenic inhibition yielded by a known dose of I^{131}. As iodine and its turnover vary from follicle to follicle, only a broad range of I^{131} dosage could be estimated.

Thirty-six rats were divided into 6 groups of 6 each and treated as follows: Group A were the controls; (B) 10 μc I^{131} intraperitoneally; (C) 30 μc I^{131}; (D) x-rays, 500 rads to the thyroid; (E) 1,000 rads; (F) 2,000 rads. Three to four months later all groups had an eleven-day course of propylthiouracil and were then sacrificed.

The average thyroid weights were compared and it was found that 1,000 rads of roentgen radiation appeared equally effective in the inhibition of goitrogenesis as 30 μc I^{131}. This latter figure can be calculated out to between 10,000 and 15,000 rads, with a range within the gland extending from 2,000 to 24,000 rads.

This higher sensitivity of the thyroid to external roentgen irradiation might be due, according to the authors, to two of many factors or their combination. First, the distribution of I^{131} in the gland is so variable that some follicles might be heavily irradiated and others not at all. Perhaps a certain minimal dose to all the follicles may be necessary before inhibition of goitrogenesis can be detected. Secondly, the difference in

effect might have been partly due to the much greater rad/minute dose given by external x-rays compared to the few rad/minute dose with I^{131}.

These results confirm many clinical findings found in the vast literature on this subject. Patients given 5,000 to 15,000 rads by I^{131} show the same 60 to 85 per cent remission rate as patients treated with 900 to 2,700 rads of x-radiation.

One table.

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Radioiodine Content of Aqueous, Vitreous, and Lens. An Experimental Study in Rabbits. Irving Shapiro, Clifford W. Gurney, and Arthur J. Solari. Arch. Ophth. **57:** 430–434, March 1957. (I. S., 1750 Medical Arts Bldg., Minneapolis 2, Minn.)

A study of the penetration of radioiodine to the aqueous, vitreous, and lens of rabbits was undertaken to determine the probability of significant corneal and lenticular damage resulting from the intrinsic radiation inherent in treatment doses of radioiodine. Eleven animals, weighing between 2.1 and 3.25 kg., were given approximately 4.5 millicuries of I^{131}. On the basis of millicuries per kilogram body weight, this approximates the dose which is presently used in the isotope unit, University of Michigan Hospital, for the treatment of thyroid cancer. The procedure employed to obtain the average number of microcuries per gram is illustrated with the calculation for the aqueous. The radiation received by the structures concerned was as follows: aqueous 13.6 rads, vitreous 4.08 rads, and lens 0.56 rads.

The authors conclude that, even with cancerocidal dosage of I^{131}, penetration of sufficient radiation to the eye to produce lens or corneal damage is highly unlikely.

Five graphs; 3 tables.

Biological Effects of I^{131} Continuously Administered to Sheep. L. K. Bustad, L. A. George, Jr., S. Marks, D. E. Warner, C. M. Barnes, K. E. Herde, and H. A. Kornberg. Radiation Res. **6:** 380–413, March 1957. (Radiological Sciences Department, General Electric Company, Richland, Wash.)

Observations over a four-year period on the biological effects of chronically administered I^{131} in sheep are reported. Daily oral administration of the isotope was employed, the feeding levels ranging from 0.005 to 1,800 μc.

Diminished thyroid avidity for I^{131} as determined by external monitoring was evident in all groups of ewes fed 5 μc or more per day and occurred before clinical changes were apparent.

With the exception of damage to structures contiguous to the thyroid, ulceration of the mouth, and lymphopenia, the effects of thyroid ablative doses of I^{131} resembled those after surgical thyroidectomy.

Clinical manifestations of damage in adult ewes fed 240 or 1,800 μc/day included lethargy, clumsy motion, constipation, bloating, diminished milk secretion, and dry skin and fleece. A depression of leukocyte count and protein-bound iodine and an increase in nonprotein nitrogen and creatinine values were observed. In addition, the first-year offspring of the ewes fed 240 μc/day exhibited a depression in hemoglobin and serum calcium and an increase in serum inorganic phosphorus values. Marked growth retardation and variable alopecia also occurred in the offspring.

Although conception occurred during the second breeding season in ewes fed 1,800 and 240 μc/day, no viable offspring were delivered.

Animals fed 135 μc/day showed clinical and pathologic manifestations similar to those observed in the 240 μc/day group but of lesser severity. The effects were proportionally milder in groups fed 45, 30, and 15 μc per day.

Pathologic examination of the thyroid glands in animals fed 240 and 1,800 μc/day disclosed the presence of chronic inflammation, necrosis, and fibrosis with eventual replacement of the glands by scar tissue. All but two adults fed 5μc of I^{131} per day for three to four years exhibited slight to moderate interfollicular fibrosis and a significant reduction in gland size.

No damage was observed in the animals fed 0.15 μc/day with a thyroid dose of about 3 rads/week. A daily intake of 0.15 μc could result from an average contamination level of 5×10^{-5} μc of I^{131} per gram of vegetation eaten by adult sheep. This suggests 10^{-5} per gram of vegetation as an MPC for grazing land.

The investigation is continuing with feeding levels of 0.15, 0.5, and 1.5μc/day to determine within a factor of 3 the quantity of I^{131} that sheep may ingest daily without damage during their normal life span.

In an addendum, the authors report that a metastasizing fibrosarcoma has developed in, or immediately adjacent to, the thyroid gland of a 53-month-old ewe.

This ewe had received 5 μc/day of I^{131} since being weaned from her dam, which had received 5μc/day during the latter one-third of gestation and all the lactation period.

Fourteen figures; 8 tables.

RADIATION EFFECTS

Mucosal Carcinomas as a Result of Irradiation. Danley P. Slaughter and Harry W. Southwick. Arch. Surg. **74:** 420–429, March 1957. (H. W. S., 30 N. Michigan Ave., Chicago, Ill.)

A moderately detailed report is given of 9 patients in whom mucosal carcinoma developed in tissues included in radiotherapy fields for various adjacent benign or malignant disease. Six of the 9 patients had squamous-cell carcinomas in areas treated by external irradiation from nine to twenty-five years earlier. In all cases there was obvious and rather marked late radiodermatitis in the skin overlying the developing carcinoma. Microscopic studies showed strong evidence of radiation change in the mucosa, submucosa, and layers of the skin, manifested by fibrosis, hyalinization, and vascular changes. In all 6 instances further treatment was unsuccessful, apparently because of the poor condition of the tissues under therapy, and the probable multicentric origin of the developing carcinomas.

The first case is one of squamous-cell carcinoma developing in the buccal mucosa, floor of the mouth, and tongue in a 53-year-old woman treated nine years earlier for malignant tumor of the left parotid gland by external roentgen therapy.

In Case 2 a squamous-cell carcinoma of the anal canal developed eleven years after radium and roentgen therapy for carcinoma of the cervix.

The third patient had had extensive roentgen therapy

to the left maxilla nineteen years earlier for what apparently was ossifying fibroma. Multicentric squamous-cell carcinoma of the buccal mucosa, gingiva, and palate subsequently appeared.

The fourth patient, a 48-year-old woman, had had multiple roentgen treatments of the skin of the neck for various dermatological conditions over a thirteen-year period prior to development of squamous-cell carcinoma of the hypopharynx. A second and presumably independent primary carcinoma appeared several months later on the posterior wall of the pharynx.

The fifth patient was a 62-year-old man presenting with squamous-cell carcinoma of the left pyriform sinus thirty-four years after external roentgen irradiation of the neck for tuberculous lymphadenitis.

The sixth case was that of a 68-year-old man with ulcerating squamous-cell carcinoma of the tongue seventeen years after irradiation of the neck for presumed anaplastic carcinoma of the nasopharynx with high left cervical node metastases.

Report is then made of three instances of adenocarcinoma occurring in areas underlying radiation changes in the skin resulting from earlier treatments for other diseases. The first patient was a woman who had received radium and roentgen treatment for squamous-cell carcinoma of the cervix four years previously. At colostomy for severe recurring radiation proctitis, an adenocarcinomatous nodule was discovered in the rectosigmoid, within the previously irradiated zone. Resection of the new carcinoma resulted in a three-year cure.

A 50-year-old man had received roentgen therapy to the epigastrium for refractory duodenal ulcer four years before his admission for what proved to be adenocarcinoma of the transverse colon appearing beneath the irradiated field. He died of metastatic disease two years later.

The third patient was a 51-year-old woman with multicentric adenocarcinoma of the cervical esophagus twenty-seven years following extensive roentgen therapy to both sides of the neck for "swollen glands" of undetermined etiology.

The authors admit that the evidence in the adenocarcinoma cases is not entirely convincing, particularly in regard to the tumors of the colon: the period following the initial radiotherapy was rather short (three to four years), and convincing radiation changes in the tissues adjacent to the tumor were not present.

Ten photomicrographs. JAMES W. BARBER, M.D.
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The Incidence of Leukæmia in Ankylosing Spondylitis Treated with X Rays. John D. Abbatt and A. J. Lea. Lancet **2**: 1317–1320, Dec. 29, 1956. (J. D. A., Department of Medicine, Postgraduate Medical School of London, London, England)

The records of two series of cases of ankylosing spondylitis from the British Ministry of Pensions and National Insurance were examined. One of these series, comprising 1,627 men, had been treated by irradiation; the other, numbering 399, had received other forms of treatment. Eighty-two pensioners had died by the end of 1955, 64 from the irradiated and 18 from the nonirradiated series. Seven deaths were attributed to leukemia; in 1 other case leukemia was given on one part of the death certificate, though death was not certified as being due to this cause. All 8 of these cases were in the irradiated group. The mean age at death was 39.7 years in the irradiated series and 40.7 in the nonirradiated; this difference is not regarded as significant.

The expected deaths from leukemia were calculated and compared with those actually observed. In the nonirradiated series 0.17 death was expected and none observed, a very good agreement between expectation and observation. In the irradiated series the expectation was 0.33 and 7 deaths occurred. The odds against this excess of deaths being due to chance were greater than one million to 1.

The results establish beyond any reasonable doubt that leukemia is associated with (1) ankylosing spondylitis, or (2) irradiation, or (3) ankylosing spondylitis treated by irradiation. The hypothesis that irradiation was the sole cause of death was tested, but the data were insufficient to provide a firm answer. It is hoped to obtain a larger series of nonirradiated individuals by using information from World War I, which may make possible a final decision on the exact role of irradiation.

In the light of other independent evidence, it is concluded that irradiation plays the main part in the production of the observed cases of leukemia.

Three tables.

Generalized Essential Reticulosis Resulting from Exposure to Radiation. Abe Towbin, Michael Kenney, and Harry Weinrauch. Cancer **10**: 385–387, March-April 1957. (A. T., State University, New York College of Medicine, New York, N. Y.)

The case reported here demonstrated all of the features of essential reticulosis and is of particular interest because of the close relationship between the development of the disease and chronic exposure to radiation. The patient had been a hospital employee for twenty-five years; during a major portion of this period he had worked as a technician, assisting regularly in fluoroscopic examinations and in the taking of roentgenograms with the hospital's portable equipment. His seven-year illness was punctuated by many episodes of infectious disease and by hemorrhagic manifestations; splenomegaly developed gradually. At autopsy, enlargement of the spleen and liver associated with rich reticulum-cell proliferation in the tissues established the diagnosis of essential reticulosis.

The relationship between the exposure to radiation and the development of essential reticulosis is of primary importance. Experimentally and clinically, the role of radiation as an oncogenic agent is firmly established. In the present case, the development of essential reticulosis is analogous to the development of cutaneous cancer and leukemia in man after chronic exposure to radiation.

One photomicrograph.

Casual Exposure of Nurses to X Radiation. B. E. Godfrey, S. B. Osborn, and Daphne J. Templeton. Lancet **1**: 363–364, Feb. 16, 1957. (B. E. G., Royal Northern Hospital, Holloway Road, London, N. 7, England)

An eight-week survey of exposure to diagnostic radiation was carried out on nurses in two wards caring for surgical and radiotherapy patients in the University College Hospital, London. Only the ward sisters knew the object of the test. During the period, a scalp treatment with a radium plaque was given in one ward and a colloidal radiogold treatment in the other, for which film badges would have been issued in any case.

The two wards investigated took care of a substantial number of patients who had undergone major chest surgery, many of whom had chest roentgenograms taken in the ward repeatedly. The amount of such work during this particular eight-week period, however, was considerably less than average. If such an examination is undertaken in the few days following the operation, as many as three nurses may be required to hold the patient and the film, and they are bound to be exposed to some of the direct beam of radiation. The extent of the exposure is shown by the fact that 5 out of 137 film badges recorded more than 300 mr in one week. That is, on the average each nurse in these wards may be expected to receive an occupational exposure of more than 300 mr not less than one week in twenty-eight, or at least twice a year. Further, the average amount of radiation per nurse-week is about 20 mr. The average dose-rate of 20 mr per week is considerably higher than that received by several groups of radiation workers in the same hospital.

On average, a nurse is unlikely to receive as much as 30 mr per week (one surgical ward) or as little as 3 mr per week (an isotope ward). The value of 10 mr per week (other wards) and 13 mr per week (second surgical ward) are more apt to be typical. Gamma radiation received from radioisotope therapy, for a group of 800 nurses, averaged only 0.1 mr per week.

In the case in which the nurse must hold the patient or film for a radiological examination, it is recommended that the nurse wear a lead-rubber apron and lead-rubber gloves.

It has long been the custom, in both diagnostic and therapeutic radiology, that relatives or ward nurses be asked to hold a patient in the beam of radiation, where this is essential. This practice may need to be modified.

Radiation Hazards with Special Reference to Diagnostic Radiology. A Review. David Durbach. South African M. J. **31:** 187–192, March 2, 1957. (Department of Radiology, Johannesburg Hospital, Johannesburg, Union of South Africa)

After reviewing recent literature regarding the dangers associated with diagnostic radiology, the author directs attention toward the deleterious effects of exposures to small doses of radiation. Emphasis is laid on carcinogenesis, leukemia, the shortening of the life span, and genetic damage, including injury to the fetus during "routine" roentgen examinations of the pregnant patient.

Some specific recommendations are made: (1) All roentgen apparatus should be regularly calibrated, especially fluoroscopes. (2) Every person should have a record of all exposure to x-rays throughout his lifespan. (3) The use of roentgenography should be kept to a minimum consistent with sound medical diagnosis and care. (4) Every effort should be made to shield the gonads, especially in patients under thirty-five years of age. (5) Should special circumstances arise where greater exposure than the "permissible" level is required (particularly when gamma rays are involved), the duties had better be assigned to persons not likely to have any more children. (6) All risks should be carefully weighed against the expected benefits.

It is stated that dangerous gaps exist in our knowledge, and research directed to the filling of these gaps is a matter of utmost urgency.

The Genetic Significance of Radiation Exposure in Atomic Energy Work in the United Kingdom in 1953 and 1954. F. R. Farmer. Brit. J. Radiol. **30:** 83–85, February 1957. (United Kingdom Atomic Energy Authority, Risley, Warrington, Lancashire, England)

Information on whole body gamma-irradiation received by employees of the United Kingdom Atomic Energy Authority is given and an assessment is made of genetically significant radiation. Monitoring procedures are discussed and maximum permissible exposure values given. During 1953 and 1954, the maximum permissible exposure was 0.5 r per week, averaged over a thirteen week period. This was reduced to 0.3 r per week in 1955.

Interest was centered upon accumulative exposure of parents prior to conception of children. It was suggested that a more precise estimation could be made by totaling the radiation exposure received prior to parenthood for each and every child born in a family.

The total exposure summed in the manner described gives a concept of roentgen-effective-genetic and is so termed in this paper. The total exposure per year received by employees of the Atomic Energy Authority, weighted according to their expectation of parenthood, is assessed as 4,357 r.e.g., which is 0.09 per cent of the r.e.g. exposure now received by the population of Great Britain due to natural radiation.

Five tables. ELDON D. VANSANDT, M.D.
Indiana University Medical Center

The Influence of Strain on Acute X-Ray Lethality in the Mouse. II. Recovery Rate Studies. Henry I. Kohn and Robert F. Kallman. Radiation Res. **6:** 329–338, March 1957. (Radiological Laboratory, University of California Medical Center, San Francisco 22, Calif.)

To determine the rate of "prompt" recovery from whole-body exposure to 250-kvcp x-rays (h.v.l., 1.6 mm. Cu), and the influence of genetic factors upon it, a two-fraction technic was employed. On Day 0 a nonlethal injury was induced by administering 350 r (tissue dose) to a number of groups of mice. One to fourteen days later a second dose was given to determine the LD 50/28. The injuring dose of 350 r was equal to 53 to 63 per cent of the LD 50/28 of previously unirradiated mice (Part I. Radiation Res. **5:** 309, 1956. Abst. in Radiology **69:** 318, 1957).

The injury on Day O caused an immediate decline in the LD 50/28 which then gradually returned to the value for unirradiated mice. The amount of injury in "r" remaining on Day x was defined as I_x = LD 50 (unirradiated mice) − LD 50 (on Day x of injured mice). The data could be treated as though injury had decreased as an exponential function of time, becoming negligible within two weeks. The half-recovery times (RT_{50}) in days for four inbred strains of mice (one hundred to two hundred days old) were as follows: A/He, 1.6; BALB/c, 2.8; C3H, 2.0; C57BL, 1.8. The difference between the BALB/c and other strains was striking.

The CAF_1 hybrid from the cross BALB/c × A/He had an RT_{50} of 2.1, approximately the average of the two parent RT_{50}'s. Parents and offspring may therefore differ in RT_{50}, and consequently in their response to fractionated dosage, on the basis of constitutional factors that presumably are genetic in origin.

Threegraphs; 3 tables. AUTHORS' ABSTRACT

Survival Studies on X-Irradiated Mice Medicated with Spleen-Preparations. Anna Goldfeder and Grace E. Clarke. Radiation Res. **6**: 318–328, March 1957. (Cancer Research Laboratory, New York University, New York, N. Y.)

The authors undertook this investigation to test the hypothesis that spleen tissue may contain a substance which enhances the regeneration of the irradiation-damaged hematopoietic system, thereby extending the survival of lethally x-irradiated subjects. Thirteen protein-free calf spleen preparations were tested for their efficacy in protecting mice against radiation induced injury. One preparation consisted of lipids alone, and one of deoxyribonucleic acid (DNA). Saline or mammalian Ringer's solution served as solvents and as control substances. Mice of three different strains (DBA, C57/BL6, and Swiss albino) irradiated with 700 r during one exposure were used.

The results show that three preparations, designated 201-A_1, 201-C_2, and 201-C_3, exerted some protection. In one instance 201-C appeared to have afforded full protection for DBA mice exposed to 700 r. This observation, however, could not be fully substantiated in two repeated experiments. The fact that spleens from different calves had been used for preparing the subsequent 201-C fractions may perhaps be responsible for these contradictory results. In contrast, the preparations designated "total lipids" exerted a harmful effect because the number of days of survival of the lipid-injected mice was significantly less ($P = 0.05$) than for the control mice. Whether or not a "humoral" factor is involved in protection afforded by spleen or bone marrow is discussed.

Four figures; 1 table.

Relationship Between Chances of Survival and Regeneration of Hematopoietic Tissue in Irradiated Rats. J. Van Lancker. J. Nat. Cancer Inst. **18**: 407–412, March 1957. (Institut du Cancer, Université de Louvain, Louvain, Belgium)

The correlation of the chance of survival and the degree of regeneration of bone marrow and spleen was studied in a group of 67 rats that received 700 r after the hepatic zone was shielded. It appears from this study that a chronologic correlation exists between the frequency of regeneration and the survival curve. The animals that died spontaneously did not regenerate bone marrow and spleen, but 44 per cent of the sacrificed animals regenerated hematopoietic tissue early (before the eighth day). After thirty days all the animals that survived had regenerated bone marrow and spleen.

Two graphs. AUTHOR'S SUMMARY

Tumor Induction in Rats by Single Total-Body X-Irradiation. R. T. Binhammer, J. C. Finerty, M. Schneider, and A. W. B. Cunningham. Radiation Res. **6**: 339–348, March 1957. (M. S., University of Texas Medical Branch, Galveston, Texas)

Female Holtzman rats were irradiated with a lethal dose of x-rays (700 r), protected by postirradiation parabiosis, and observed for their entire life span for late effects. Cataracts developed in all irradiated rats which survived for a year or more.

In 46 per cent of the rats irradiated with 700 r and maintained in parabiosis for from four to thirty days, neoplastic growths were observed; the 45 tumor-bearing animals had 69 neoplasms, 52 of which were considered malignant and 17 benign. Only a single tumor (benign) was found in the 58 nonirradiated partners acting as controls. In rats receiving sublethal irradiation, there was a tumor incidence of 30 per cent (in 12 of 40 animals). In 28 pairs of rats irradiated with 700 r and maintained in parabiosis for the entire life span, 10 (36 per cent) of the irradiated partners were tumor bearers; 3 nonirradiated animals (11 per cent) also had tumors. Over half of the tumors were located subcutaneously in the axilla or groin, and many of these were of mammary gland origin; sarcomas, carcinomas, and other tumors of various organs were also found.

Administration of croton oil increased the number of tumors in irradiated rats, but injection of growth hormone and painting of the skin with methylcholanthrene had no cocarcinogenic effect in this study.

Irradiation in this investigation was primarily in the dose range which causes death by hematopoietic damage with minimal intestinal injury, and tumors were primarily nonintestinal.

The hypothesis is presented that dose ranges or type of radiation which affect the intestine severely (1,000 r x-rays; fast neutrons) induce intestinal tumors, whereas tumors due to lower x-ray doses (700 r) and gamma radiations, with more rapid epithelial recovery, are not of intestinal origin.

Eight tables.

Effects of X-Irradiation on Renal Function of Rats. L. H. Smith and W. R. Boss. Am. J. Physiol. **188**: 367–370, February 1957. (L. H. S., Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

In a study of the direct effects of irradiation on the renal function of rats whose exteriorized kidneys were exposed to massive doses of x-rays (2,500 r, 3,000 r, or 4,000 r), significant augmentation of the urine flow was observed twenty-eight days after 2,500 r. On the seventh day after 2,500, 3,000, and 4,000 r, the urine flow was slightly above that of control rats. The glomerular filtration rate was enhanced on the seventh day after 2,500 and 3,000 r. Conversely, twenty-eight days after these x-ray doses the filtration rate was slightly below the control values. In the 4,000-r, twenty-eight day group, the glomerular filtration rate was 43 per cent below that of the controls. No significant changes in the renal plasma flow occurred on the seventh day after 2,500, 3,000, and 4,000 r. An insignificant increase in the renal plasma flow was observed twenty-eight days after 2,500 and 3,000 r. On the twenty-eighth day after 4,000 r, however, the renal plasma flow was 51 per cent below that of the controls.

The authors conclude that both augmentation and depression of renal function were the result of the direct action of x-rays on the kidneys. The results also suggest that renal failure resulting from direct irradiation damage to the kidneys is not a major factor contributing to deaths within seven days after the exposure of rats to 4,000 r or less of whole-body x-rays.

One table.

Leukocyte Changes During Acute Cross-Circulation Experiments Between Leukemic and Normal or Irradiated Rats. J. W. Hollingsworth and S. C. Finch, with the technical assistance of Mary Chaltas. Blood **12**: 130–139, February 1957. (Yale University School of Medicine, New Haven, Conn.)

Normal and irradiated rats underwent periods of cross-circulation with Shay granulocytic chloroleukemic

rats. The leukemic white blood cells disappeared rapidly from the arterial blood of the irradiated rat at a rate approximately identical with that of the removal of cross-transfused normal leukocytes. Many leukemic cells remained in the arterial blood of normal recipient rats during the ninety-minute observation time after cross-circulation. It is postulated that leukocytes transfused in rats by this method remain viable. In the irradiated leukopenic recipient, the rapid arterial blood removal rate of transfused cells may represent distribution in a depleted total body leukocyte "pool." Similarly, distribution may occur more slowly in normal animals with normally saturated tissue stores of leukocytes. There was no indication that a large dose of total body irradiation increased the capacity of the reticuloendothelial system to remove transfused leukocytes from circulation.

Six graphs. AUTHORS' SUMMARY

Viability and Distribution of Leukocytes Following Cross-Circulation Experiments Between Leukemic and Normal or Irradiated Rats. J. W. Hollingsworth and Stuart C. Finch, with the technical assistance of Mary Chaltas. Blood **12:** 140–146, February 1957.

Recipient rats were observed following periods of circulatory mixing with normal or leukemic blood donor animals. The normal rat tail appears to store leukocytes in its vascular channels, as evidenced by a progressively falling leukocyte count from a tail incision as the tail is "milked."

Comparison of irradiated rat tail and arterial blood leukocyte counts during and after cross-circulation revealed the tail values to be consistently higher than the simultaneous arterial levels. This observation excludes a major removal and destructive mechanism by some organ such as the lung as a major cause of the rapid decrease in arterial blood leukocyte levels noted in irradiated rats after the cross-circulation procedure. Tail blood leukocyte counts of irradiated, cross-transfused rats remained higher than those of control irradiated rats for at least three days.

After cross-circulation with leukemic donor rats, leukemic cells were identified in the tail blood of normal rats for at least three days. Prolonged observations revealed that 2 irradiated Sprague-Dawley strain recipients of leukemic cells from Sherman strain leukemic donors survived the severe radiation damage but developed leukemia. This observation suggests that transfused leukemic white blood cells protect against radiation damage.

Five normal Sherman strain rats developed leukemia after cross-circulation with leukemic Sherman donors. This incidence (50 per cent) of transmission to adult animals is much higher than has been reported by conventional methods of transfer.

The observations reported support the concept of viability of leukocytes transfused in rats by this method, and suggest that at least one site of noncirculating transfused leukocytes is within sluggish vascular channels.

Three charts. AUTHORS' SUMMARY

The Effect of Irradiation on the Plasma Erythropoietic Stimulating Factor. James W. Linman and Frank H. Bethell, with the technical assistance of Helena K. Tascott. Blood **12:** 123–129, February 1957. (University of Michigan Medical School, Ann Arbor, Mich.)

Protein-free plasma extracts from adult New Zealand rabbits made anemic by the administration of phenylhydrazine immediately following total body x-irradiation are capable of stimulating erythropoiesis in the normal rat, as demonstrated by erythrocytosis, reticulocytosis, and increased marrow erythropoietic activity.

Plasma extracts from animals made anemic by total body x-irradiation alone contain an erythropoietic stimulating factor.

These data would indicate that the stimulating factor is not produced by hemopoietic or other radiosensitive tissue and its formation is not dependent upon a regenerative marrow.

Three graphs; 2 tables. AUTHORS' SUMMARY

A Substance Observed Within the Vascular System of Dogs Receiving Lethal Exposures of Whole-Body X-Irradiation. A. C. Andersen. Radiation Res. **6:** 361–370, March 1957. (School of Veterinary Medicine, University of California, Davis, Calif.)

It is well established that the primary effects of ionizing radiation are prerequisite to radiation sickness and death. The pathological sequence of events, however, explaining the cause of death from ionizing radiation has not been established. The author presents a possible explanation, from a histological standpoint, of some lesions observed at necropsy.

Forty-one purebred beagles between ten and twelve months of age were exposed to whole-body x-irradiation through various seasons in 1955. Twenty-five (62.5 per cent) of the dogs receiving a surface exposure of 500 r died an average of sixteen days following irradiation. Although seasonal and other causes for variations as to the time of death after irradiation did occur, an unidentified substance was found consistently within the blood vessels of all the dogs succumbing to irradiation. It appeared as a mass within larger blood vessels and as globules within capillaries. Tests showed this substance to be a complex polysaccharide. It was not observed in control dogs or in dogs sacrificed before the development of clinical signs of radiation sickness; therefore, it is presumably a secondary result of irradiation. Bacterial stains failed to disclose evidence of microorganisms within this polysaccharide material.

It is suggested that globules of this material are related to capillary congestion and hemorrhage developing late in the irradiation syndrome seen in dogs.

Three photomicrographs; 1 photograph.

Nature of Serum Protein Changes in the X-Irradiated Dog. William H. Goldwater and Cecil Entenman. Am. J. Physiol. **188:** 409–414, February 1957. (Biochemistry Branch, U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

Serum protein, lipoprotein, and glycoprotein patterns were studied in irradiated dogs, with paper electrophoresis technics. Alpha-1 globulin lipid decreases in the terminal stages following fatal doses of x-radiation, this change reflecting a loss of lipoprotein. Considerably increased levels of alpha-2-3 globulin lipid and polysaccharide in extremely sick or dying dogs result from increased concentrations of lipoproteins and glycoproteins. Decreased alpha-4 globulin polysaccharide is a function of a loss of glycoprotein, while slight increases of beta globulin lipid reflect gains of beta lipoproteins. The loss of alpha-4 and gain of alpha-3 glycoproteins have been found as early as ten days prior to irradiation death and in the absence of lipoprotein or body temperature abnormalities. In dogs surviving irradiation

doses near the LD 50, transitory lipoprotein changes are slight, while glycoprotein derangements are more pronounced. Mechanisms underlying these various changes are discussed.

Three figures.

Pharmacological Studies on Irradiated Animals. V. The Effects of Postirradiation Administration of Vitamin K on X-Ray Induced Mortality. Friedrich Ellinger. Radiation Res. **6**: 355–360, March 1957. (Naval Medical Research Institute, Bethesda, Md.)

A study was made of the effects of the postirradiation administration of vitamin K on x-ray-induced mortality. Guinea-pigs were given doses of 325, 425, and 500 r/air, representing the LD 39/15, LD 73/15, and LD 97/15, respectively, under the conditions of the experiment. The vitamin K was administered intramuscularly as menadione sodium bisulfite; daily injections of 4 mg. in 1 ml. were given to the guinea-pigs irradiated with doses representing the LD 39/15 and LD 73/15; the same dose was given twice daily to those exposed to the LD 97/15 for five days, starting within a few minutes after the exposure, as a means of doubling the daily vitamin administration.

Postirradiation protection against x-ray mortality by vitamin K injection was demonstrated at the LD 39/15 and LD 73/15 levels but not at the LD 97/15 level.

Autopsy examination revealed a definite reduction of x-ray-induced bleeding manifestations in the gastrointestinal tract at the LD 39/15 level, but no important changes were observed at the two higher x-ray doses.

There was also a reduction in the fatty changes produced by irradiation in the livers at the LD 39/15 and LD 73/15 levels of mortality, but not at the LD 97/15 level.

Histopathological studies revealed that vitamin K administration did not modify the radiation effect produced in spleen and bone marrow.

From the accumulated evidence it is concluded that vitamin K may affect some process related to the recovery of the animal from irradiation, but no definite explanation of the action mechanism can be advanced at the present time.

One graph; 1 table.

Interpretation of Radiation Results Based on Target Theory. Aadne Ore. Radiation Res. **6**: 27–39, January 1957. (Universitetets, Fysiske Institutt, Avd. D., Blindern, Oslo, Norway)

This paper represents a quantitative discussion of certain approximations commonly being used in the statistical analysis of radiation data in terms of size, shape, and sensitivity of macromolecules and macromolecular functional units.

It is shown that the current approximate procedure of comparing radiation data which obtain for different radiations, usually will be accurate to within a few per cent. The variation in observed cross-section with radiation dose, which is sometimes to be expected, is also discussed, together with the feasibility of comparing, in such cases, the results obtained with different radiations. Tables and formulae are presented which may be useful in the analysis of experimental results.

Three figures; 7 tables. AUTHOR'S ABSTRACT

Studies on Trichinella spiralis. VI. Effects of Cobalt-60 and X-Ray on Morphology and Reproduction. S. E. Gould, H. J. Gomberg, J. B. Villella, and C. S. Hertz. Am. J. Path. **33**: 79–105, January–February 1957. (S. E. G., Wayne County General Hospital, Eloise, Mich.)

Encysted larvae of *Trichinella spiralis* were exposed to various doses of cobalt 60 and of x-rays and then fed to white rats to determine the effect of these forms of radiation on prevention of reproduction of the worms, on the rate of elimination of the worms from the intestine of the host, and on the length of the body of intestinal trichinae at various intervals after infection. In addition, direct observations were made, on living and fixed trichinae, of morphologic changes appearing at various intervals following infection with larvae exposed to different doses of radiation.

In each instance in which the effects of cobalt 60 and x-rays were compared, it was found that the dose of cobalt necessary to produce a given effect was approximately three times that of x-rays. The striking difference in dosage between the two forms of radiation is believed to be due to the difference in distribution of ionization. This is now being investigated.

Exposure of Trichinella larvae to 5,000 to 10,000 rep cobalt 60 or to 2,000 or 3,000 r x-rays greatly reduced their reproductivity; doses of 12,000 rep and over of cobalt and 4,000 r and over of x-rays produced sexual sterilization of practically all trichinae.

Morphologic changes were observed in female Trichinellae at various intervals from twenty-four to one hundred and forty-four hours after infection of white rats with larvae exposed to cobalt 60 or to x-rays. Irradiation of trichina larvae (with 6,000 rep or more of cobalt 60 or 2,000 r or more of x-rays) produced decreases in body length, when measured three and six days after irradiation. Exposure to 18,000 rep cobalt or 6,000 r x-rays resulted in severe stunting of growth as early as twenty-four hours after infection. Six days after exposure to 2,000 r x-rays, the gonads of both males and females showed evidence of degeneration. After 4,000 r practically no females were inseminated. Growth of males and females was severely stunted. The females exhibited extensive degeneration and shrinkage of the ovaries, and thickening and nodular swelling of the cuticle. It seems likely that granular degeneration and disintegration of the egg cells was a factor in causing obstruction of the vagina and vulva.

Seventeen figures; 2 graphs; 6 tables.